MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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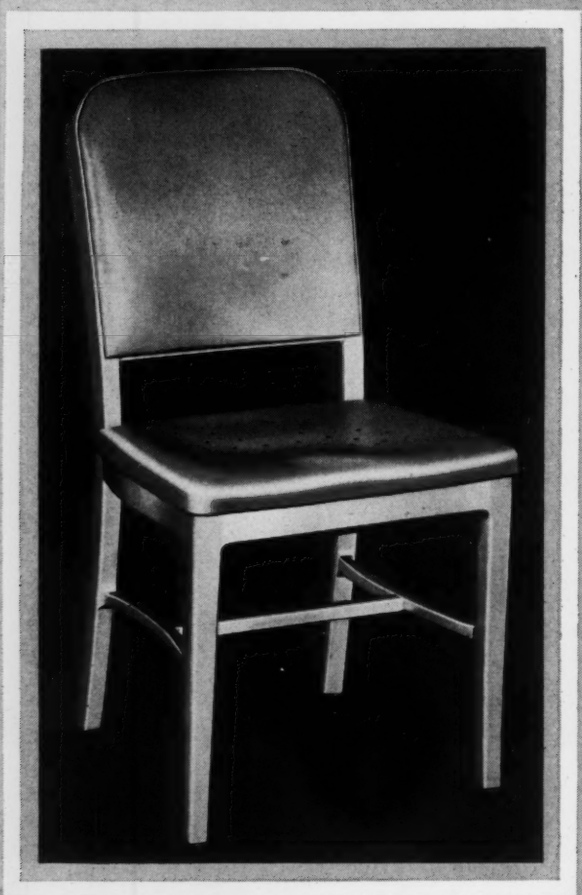
How WELDING– *makes Better Furniture*



Oxy-acetylene welding has made this modern metal chair jointless. The result is smoother finish, increased durability, added beauty, lower upkeep, greater strength and lighter weight. Similarly, in other industries, oxy-acetylene welding allows great freedom of design, improves countless products and saves money for thousands of manufacturers.

You, too, may find it profitable to investigate the production and sales advantages which welding can bring to your products. Linde engineers will gladly cooperate with you in adapting oxy-acetylene welding to your product designing. This help is available from your nearest Linde office. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and principal cities.

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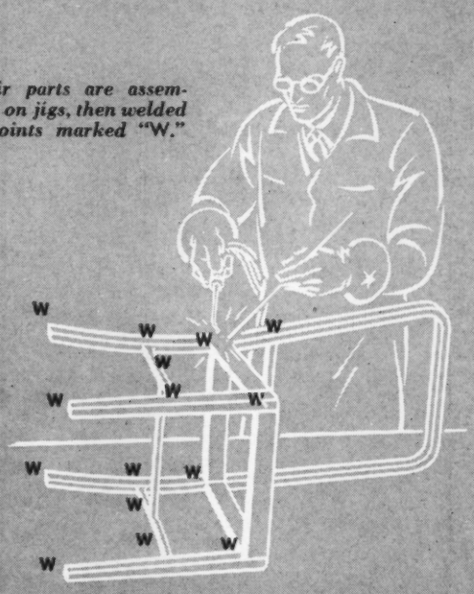
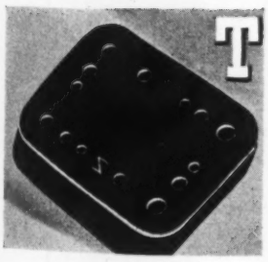


Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES

FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE

SYNTHANE *Materially* AIDS LIGHTHOUSE KEEPING



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SYNTHANE
LAMINATED BAKELITE

TOPICS

DIESEL power for automobiles, though practical from a mechanical standpoint, is years away from actual application, we learn from a diesel authority. Before any widespread use of this type of engine can be made, thousands of garage men and gas station attendants must be inculcated with the intricacies of diesel design and operation. Motorists who have grown up with the gasoline engine must learn all over again the temperament of a diesel engine. And the most crushing blow of all: When diesels are in as widespread use as gasoline engines the cost of fuel oil will be on a par with gasoline, so what do we gain? Evidently we don't need to worry—our gasoline driven autos will be popular for a good many years yet!

♦ ♦ ♦

Master craftsmen have just about passed out of the picture in this industrialized, high production era of ours. We've learned, however, of one man who has almost a monopoly on the production of glass lenses for airplane landing lights. It seems that these lights which are built into the wings of our large transports must have lenses that not only refract the light rays properly, but are in the perfect form of a water drop to offer the least wind resistance. This master craftsman has his shop in Urbana, O., and is a glass blower of long standing. We understand he supplies most of the airplane manufacturers in the U. S. with these peculiarly shaped lenses.

♦ ♦ ♦

Cut-throat competition which has grown to such proportions in the United States is apparently taking a backward step. Two well known railroads, bitter competitors for half a century, have combined their staff engineers in collaborating on the design and construction of entirely new passenger equipment for their crack trains. Both railroads, according to our information, have been experimenting with this new type of equipment for some time and suddenly decided that their interests could best be served by joint action, thus reducing needlessly large expenditures in individual tests and research.

♦ ♦ ♦

Rolling pipe in a manner similar to the manufacture of cigarettes is the feat of a new machine recently placed in operation. The pipe is made of a mixture of 85 per cent cement and the remainder asbestos, and is said to be far superior to other kinds of pipe for many uses. In its fabrication a wet mixture of the two substances is picked up by a continuous felt belt and deposited on a revolving steel mandrel. The pipe is slowly built up, adding four one-hundredths of an inch to its thickness on each revolution of the mandrel. Steel pressure rolls bearing on the deposited mixture as it revolves on the mandrel produce a dense, hard, homogeneous structure. The pipe will not be disintegrated by electrolysis, is not easily crushed and will not become encrusted with interior deposits which cut down the flow.

♦ ♦ ♦

Glass as a form of clothing, drapes or blankets sounds ridiculous, yet it is being manufactured commercially for these very uses. Spun glass has been used for 20 years as an insulator and during the war was placed in many battleships as an insulator that was not affected by salt water or acid solutions. Last month at a meeting of the American Ceramic Society, a representative of a large glass company told the members, "The tensile strength of individual glass fibers averages 250,000 pounds per square inch. Glass yarns have at least as high knot strength as other yarns, when properly constructed." Glass has been used with unquestioned success as an insulating agent for winding electrical wires and its dielectric strength in tape form is high, comparing favorably with varnished cambric. All of which means that engineers will have to get busy designing glass weaving machines. Ordinary clothing fabrics will be old fashioned soon.

What Not To Patent

2,072,876
PHONOGRAPH CONTROL
Clifford H. Green, Grand Rapids, Mich., assignor to Automatic Musical Instrument Company, Grand Rapids, Mich., a corporation of Michigan
Application February 5, 1934, Serial No. 709,691
2 Claims. (Cl. 274—10)

By George V. Woodling

IT IS highly essential that good judgment be exercised just as soon as an invention is conceived. From this point on, every subsequent action should have individual and careful attention. A meritorious invention may become commercially "wrecked" if improperly managed. On the other hand, an invention representing only a very small advance in the field may be made commercially important when properly handled. The history of inventions is full of such occurrences.

The foregoing holds true regardless of whether the inventions are owned and managed by the inventor himself or by a corporation. Because a few of our larger corporations have massed huge fortunes by efficient management of their patents, we ordinarily look upon them as being good managers of patents. This is not altogether true. Corporations, in general, are just as guilty of errors in judgment as are individual inventors, who, as a class, are generally considered to be poor business men.

When dealing in patents no one is immune from mistakes, and consequently the best handling is none too good. Situations which impair or reflect unfavorably upon past actions are bound to turn up when least expected, regardless of how carefully the actions might have been planned. For this reason,

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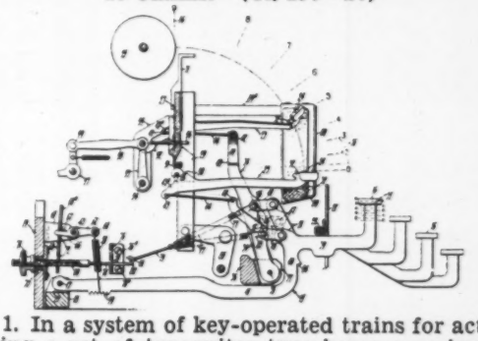
it[illegible] part, t[illegible] fac[illegible] that forms the floor of the socket having a plurality of recesses, a standard having a base receivable in the socket of the gear wheel, a plunger mounted in the base of the standard, a spring normally urging the plunger into any one of the recesses, a bar on the upper end of the plunger, and a member on the standard having a cam surface and a recess adjacent the upper end of the cam surface, the cam surface and recess being engageable by the bar of the plunger.

2,072,878
TYPEWRITING MACHINE
William F. Helmond, West Hartford, Conn., assignor to Underwood Elliott Fisher Company, New York, N. Y., a corporation of Delaware
Application February 23, 1935, Serial No. 7,679
10 Claims. (Cl. 197—27)



1. In a system of key-operated trains for actuating a set of typewriter type-bars; a series of type-key levers extending from a keyboard to a mean fulcrum-axis, a series of upstanding graded sub-levers connected to the type-bars, said sub-levers arrayed transversely of the machine at a [illegible]one between the keyboard and the key-lever ful[illegible]-axis, and a series of links connecting the [illegible]ers and sub-levers at graded elevations, [illegible]s being arranged so that each link be[illegible]inclined to its sub-lever as the [illegible]roke progresses, to thereby [illegible] and its type-bar, the ac[illegible]ther arranged with their [illegible] to the sub-levers and [illegible]ly at substantially [illegible] ful[illegible] in

Fig. 1—Patent research cannot be carried on without the Patent Office Gazette, which covers all legitimate patents

carefulness is not in itself sufficient insurance against making mistakes. Thoughtful action must be accompanied by a sound patent policy which acts as a guide to careful planning, and as a solution to each specific patent problem as it arises.

From the standpoint of adequately serving the needs of a company, the patent policy should be made up of the consolidated ideas of the engineering, sales, executive and patent departments. To obtain these consolidated ideas, quite a few of the larger corporations have established patent policy committees or patent boards composed of representatives from the various departments who meet and act upon the broad aspects of all patent matter affecting the company's interests. The detailed aspects of the specific problem are then usually delegated to, and worked out by, the patent department or patent attorney.

One of the major problems coming under the general patent policy of a company is to determine "when to apply for a patent." To some readers this problem may, at first, appear to require very little attention. The solution is, of course, obvious in those cases where the nature of the invention and its probable worth clearly indicate whether it should be abandoned or protected by filing a patent application. The difficulty in knowing "when to file a patent application" resides in the border line inventions. Here the question becomes a serious one.

Factors To Be Considered

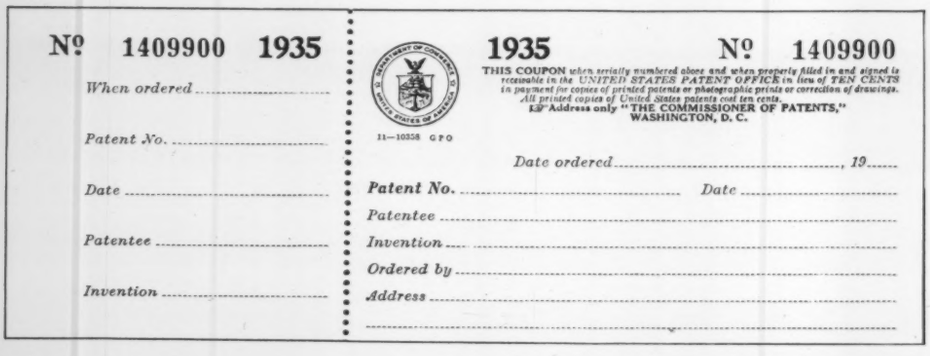
In order to reduce to a minimum the mistakes regarding "when to file a patent application," the following procedure, centralized around a well coordinated plan of checking, is suggested:

1. Carefully consider the engineering merit.
2. Estimate the sales value as accurately as possible.
3. Determine the patentability of the invention.

This plan affords a check against going too far ahead and spending too much money without the remotest chance of receiving an adequate return. The order of making the engineering, sales and patentable investigations ordinarily depends upon which can be made quickest and cheapest and which will benefit the company most. For instance, the chief engineer may want to hold up the engineering investigation until the patent attorney has made a search of prior patents, on the theory that if the patent search reveals the idea is not patentable, then there will be no need to spend money on an engineering investigation. The sales manager may entertain the same idea. Or the patent attorney may want to hold up the patent searches until the engineering and sales departments find out if the device is practical and possesses sales value. As a general rule it is best to make the patent searches and investigations first, because on the average they cost less than the engineering and sales investigations. Moreover, a patent search may reveal interesting patents which may cause the engineering department to abandon its former plans and design an entirely new line of products.

Device Must Be Practical

In checking the engineering merit, it is a good plan to ask yourself at the outset these or equivalent questions: "Is the idea practical?" "Is it not only better, but also cheaper?" The invented product must be so good that companies or individuals will want to buy it and must be so easily manufactured that they can afford to pay for it. Manifestly, if the invention is impractical it can never be successfully manufactured and sold. The prospective customer will simply refuse to buy the product, and the fact that the invention may be patented will not make the customer buy it any quicker than would be the case if it were not patented. Notwithstanding, this obvious fact, there are quite a few inventors who entertained the idea that a patent adds value to an impractical device, and consequently they feel that such a device can be made practical by having it patented. Nothing could be farther from the truth. This misconception probably results from the fact that these inventors imagine that the Patent Office puts a stamp of engineering approval upon their inventions before it grants them their patents. It is a mistake to think that the Patent Office conducts an engineering laboratory. The most that the examiners of the Patent Office do is to check whether the invention is obviously operative and whether it possesses utility. However, a device may be operative and possess utility in a patentable sense and yet be wholly impractical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When ordered
Patent No.
Date
Patentee
Invention
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Fig. 2—Books of coupons for ordering patent papers may be obtained from the Commissioner of Patents. These serve the purpose better than handwritten informal orders

in a commercial sense. About the most that a patent can be when granted upon impractical devices is a mere patent on paper and not in fact.

These paper patents usually result from the fact that, too often, a patent is hastily filed from the first rough sketch of the invention, or from the fact that the inventor is not capable of perfecting his invention or, if capable, that he does not take the time. It is very seldom that the ideas embodied in these first rough sketches are so perfect that they cannot be improved, particularly from the standpoint of simplifying and reducing the number of parts and the manufacturing costs, important factors in making the invention practical in the commercial world. Or the invented device itself may seem practical, but the shop machinery and tools which are necessary to manufacture the device may require more ingenuity to develop than the device itself, and may thus be so costly that the profits derived from merchandising the device would not make a good investment for the manufacturer.

The thing to do, after conceiving the original idea and after making the first rough sketch, is to keep on thinking and making more sketches, discarding the impractical ideas and grouping and reorganizing

THE author of this contribution, one of the concluding articles in an extended series on patents, needs no introduction to Machine Design's readers. His articles have been accepted wholeheartedly by engineers responsible for design. Requests for reprints have been so numerous that Mr. Woodling has been asked to extend, revise and bring up-to-date his entire series for the purpose of publication in book form. This volume should make its appearance at a comparatively early date

parts of the better ideas until every possible way of producing the invention is exhausted and the cost of manufacture is reduced to a minimum. Next to costs, the main objective to seek is to design your machine so that it possesses merit over the existing machines or device already on the market. If you find that your machine can be made as cheaply as the existing products, and yet constitutes an improvement over them, there should not be much difficulty in attaining success.

If the invention can readily be made into a model and tested, this preferably should be done; but, if the model and the testing are going to be too expensive, it may be better to conduct a patent search first to determine whether or not the invention is patentable. Whenever engineering tests are made they should be conducted intelligently and should duplicate as

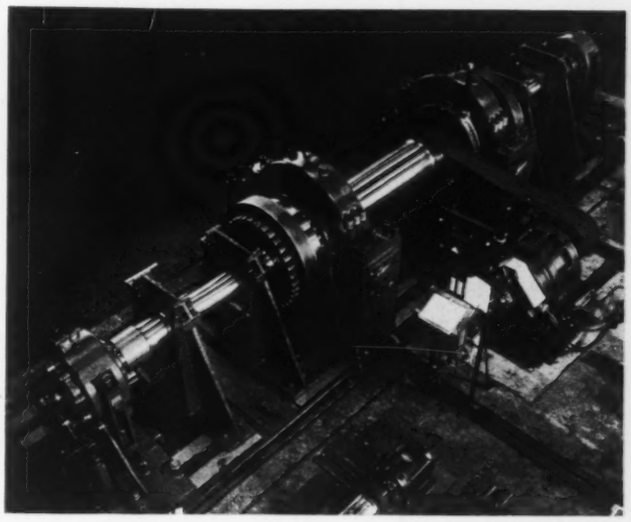


Fig. 3—Typical machine, the only one in existence, on which patents are not likely to be taken out

nearly as possible the actual working conditions under which the invention is to be used. The making of additional sketches in the process of improving the invention and the making and testing of models must be diligently pursued. If too much time is wasted another inventor may enter the field and may be awarded, in an Interference proceeding, the priority.

Some companies like to wait until all of the detail and working drawings of the finished embodiment are complete before filing. This is a good plan if the finished drawings can be produced within a few weeks. A short delay ordinarily will not jeopardize the inventor's rights in the case of an Interference. In the event that it will take several months to complete all the detail and working drawings, ordinarily the case, it is considered best to file the patent application upon the broad idea and not wait for the finished drawings. This may be easily done because it is not necessary to specify in the patent application the dimensions and the sizes of the parts or the material from which the parts are made, unless they constitute the gist of the inventive idea. But when filing upon the broad idea, care should be exercised to make certain that all the essential parts and the manner in which they co-operate are well covered in the application.

Regarding the sales value of the invention, it is a difficult job to obtain a good and fair commercial report strictly based upon facts and some companies, not infrequently, test out the commercial value of an invention by actual manufacture and sale before applying for a patent. If the market proves favorable, they then proceed to file the necessary patent application to protect the device. This plan, while it is the surest way of determining the commercial value, is not the safest thing to do from the patent point of view, because it invites patent troubles with those who have seen the device, usually through Interferences.

The object of a market survey is to serve as a

check on filing upon every invention made by an individual inventor or upon every engineering disclosure that is submitted to the patent department of a company. Among engineering patent disclosures, there are many border line inventions which have a questionable value and the purpose is to exclude these unimportant cases and concentrate all effort of the patent department or attorney upon the prosecution of the valuable inventions.

A device may possess engineering merit and sales value over existing devices, and yet not be patentable because it shades too close to certain prior patents. The best way to find the prior patents is to conduct a search among the patent files in the United States Patent Office at Washington. Some of the larger manufacturing corporations keep in their own plants a complete file of all the patents pertaining to the products which they manufacture. In these cases a complete search may be made in the company's patent files without the need for conducting a search at the Patent Office.

In order to keep the files up to date and to make sure that no pertinent patent has been overlooked, the patent department or attorney must check the

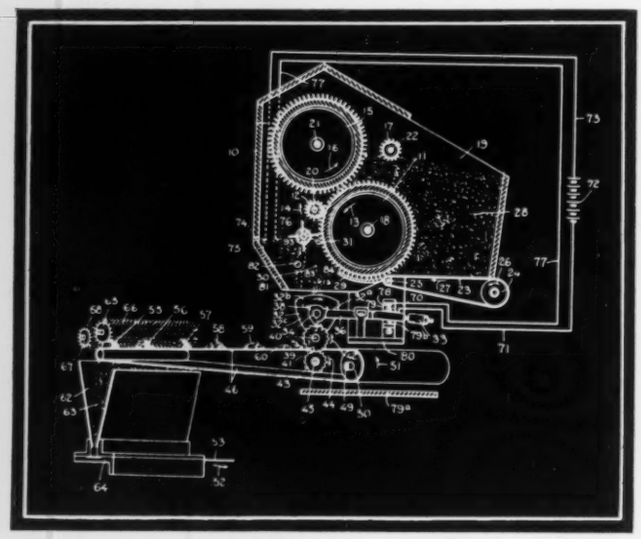


Fig. 4—In restricted markets, such as for cigarette machines, the copying of a patent can be readily verified

new patents as fast as they are issued each week by the Patent Office. To do this, the attorney checks the *Patent Office Gazette,* a portion of a page of which is shown in *Fig.* 1. The *Gazette* is published weekly and gives a drawing and a claim of all of the patents issued for the current week. Ordinarily the drawing and the claim are sufficient to let the attorney know whether or not the patent is pertinent to the company's business. The *Patent Office Gazette* is mailed under the direction of the Superintendent of Documents, government Printing Office, subscriptions, $16; single copies 35 cents. Circular and general information concerning patents may be obtained upon request and without cost by writing to the Commissioner of Patents, Washington, D. C. Printed copies of patents are furnished by the Patent Office for 10 cents each.

The ordering of patent copies from the Commissioner of Patents, Washington, D. C., may be greatly facilitated by using coupons such as shown in *Fig.* 2 which may be purchased from the Patent Office in lots of 20 at $2.00 and in lots of 100 at $10.00. When ordering copies of patents by coupons it is not necessary that the coupons be accompanied by letters of transmittal.

Patents May Not Be Warranted

Regardless of the fact that a device may sparkle with inventive ingenuity and be readily patentable, there are four general types of inventions where patenting usually does not pay. These include:

1. Inventions which have a short commercial life, particularly those which die out in one or two years
2. Inventions which relate to large special shop machines, usually designed to facilitate speed in production in a manufacturing plant, and built for that particular manufacturing plant
3. Inventions which relate to special machines made by the company itself for its own plant
4. Inventions which may be safely marketed as a secret.

The inventions under item 1 ordinarily relate to games, cheap toys and other novelty items which usually take the public by storm, and last for about one season. The reason that patents are of very little value in keeping exclusive market control of these games, toys and novelty items is that infringers may "flood" the market in a few months, and by the time the aid of the court is secured the damage is done.

In discussing the inventions under item 2, let us suppose that the chief engineer of a company which specializes in making large shop machines is called in by the factory manager of a manufacturing company and is asked to design a particular machine for speeding up the manufacture of the latter's product. The special machine may be an improvement over existing inferior machines of small capacity, or may be designed to perform a task formerly done by hand. In cases of this nature, the factory manager usually specifies the production requirements and leaves the details as to the particular form and design of the machine to the chief engineer, or the purchasing company may design the machine completely. Within due course, an agreement is perfected regarding the purchase of the first machine, the manufacturing company withholding the purchase of other machines until it has determined how the first machine succeeds. It is of course obvious that the large engineering and development expenses which are usually incident to the construction of the first machine cannot be totally charged to it. This means that the first machine in many cases is sold at a loss or at very little profit with the hope that the cost will be regained in sub-

sequent purchases of similar machines. Quite possibly, such additional machines may be exceedingly remote as in the case of the Timken designed railway axle testing machine of *Fig.* 3, the only one of its kind.

Now, let it be assumed that the question arises as to whether or not it is best to protect the machine or certain parts of the machine by a patent. The criterion for determining this question rests solely upon whether or not the manufacturing company is considering additional machines, whether it will purchase such machines from the chief engineer's company or whether it will attempt to purchase additional machines elsewhere, or make the machines itself. In other words, if the chief engineer's company feels that the purchase of the additional machines is "in the bag," or that only a very few or no additional units will be desired, it may not be necessary to take out a patent, as the patent will not be of any assistance in maintaining the monopoly already assured.

First Company May Be Loser

However, in cases such as this it is not uncommon for the purchasing department of the manufacturing company to call in other companies to bid upon the additional machines. If this is done, the other companies can usually underbid the first company, because they do not have to liquidate the original development expense. They can copy their design directly from the first unpatented machine. As a result, the first company is sometimes the loser. Therefore, if there is a feeling of doubt as to the exclusive control over purchase of the additional machines, it may be advisable for the first company to apply for patent protection and use the patent to retain such control. Or, and most important, if certain parts or mechanisms in the machine can be used in other devices, it would be best to secure patent protection.

In discussing item 3 it is important to remember that the purpose of a patent is to prevent others from making the same invention. Now let us suppose that a large manufacturing company makes a special machine in its own plant for its own use, and that the company obtains a patent for this special shop machine. When the abstract of this patent is published in the Patent Office *Official Gazette*, other competing companies learn of the invention and can order a copy of the patent from the Patent Office for 10 cents. The competing companies may then manufacture and use the same machine in their own shops, hoping when they do so that the first company will never learn about it. This would mean that unless the first company employs special agents to discover the deception, it could not effectively enforce its patent rights and the infringing companies could carry on for years in violation of the patent. In other words, the first company is merely educating the competing companies to make the same shop machines.

The policy of not applying for a patent upon shop machines made by a company for its own use has been adopted by several large manufacturers. In theory, it may seem plausible to apply for a patent upon shop machines made by the company, because if it can prevent competitors from using similar machines the first company has certain manufacturing advantages over the competing companies. But the theory does not work out in practice since the first company cannot effectively enforce its patent rights.

However, there are two exceptions where it may

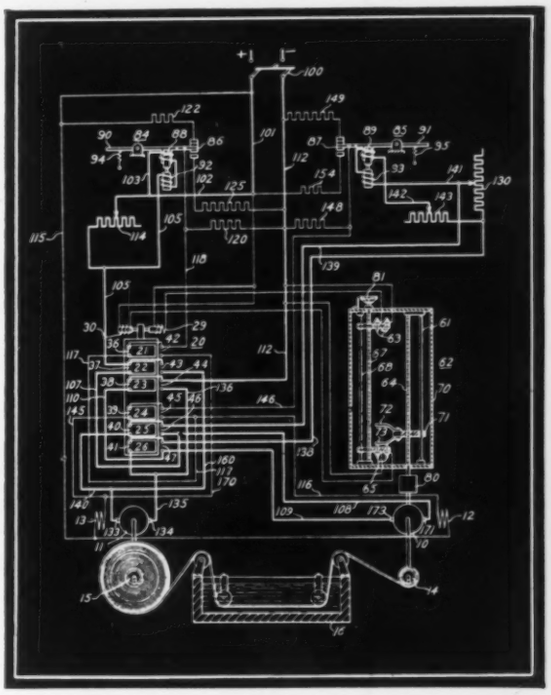


Fig. 5—Patents are often taken out on control circuits to clinch certain manufacturing rights

be desirable to apply for a patent. The first exception is where there are very few competing manufacturers, in which case it would not be very difficult to learn whether or not they had copied the patent. Take for example the manufacture of electric light bulbs. These light bulbs are made by only a few companies and in this case it would not be difficult to learn what the other companies were using. Another example of this situation is in the field of cigarette machinery including units such as that shown in *Fig.* 4. The other exception is where there is only one way in which the company's product can be manufactured, and if the patents upon the first company's shop machines cover this one method, then the first company can feel fairly certain that if the other companies are making the product they are making it with a similar machine. It should be noted that both of these exceptions arise from the

(*Continued on Page* 142)

SCANNING THE FIELD FOR IDEAS

WITH the adoption of roller conveyors for heavy duty work in foundries and steel mills, where in extreme cases loads as great as 40,000 pounds sometimes are imposed upon the system, some method of insuring proper distribution of the load over a number of rollers has become necessary.

Mathews Conveyor Co. has met this problem by means of resiliently mounted shock absorbing roll units, of which a diagrammatic view is presented in *Fig.* 1. The unit shown is made up of a pair of rollers mounted one at each end of a pair of *L* members which are tied together front and rear by inverted *L* sections welded in place.

There are four heavy springs, one at each corner of the unit, their placement and method of functioning being obvious from the drawing. The effect of the spring support is two-fold. In the first place it prevents injury to the rolls and their bearings when heavy loads are dropped on the conveyor at the loading point. When coils of steel are being handled by a magnet a total weight of 35,000 pounds sometimes will be dropped on the rolls if the crane operator is not unusually careful.

In the second place, uneven objects even when carried on skids tend to concentrate the load on two of the solidly supported rollers instead of the ten or more which theoretically are carrying it. When the spring support is used, the two on which the load bears most heavily are pushed down slightly and the others pick up their share of the weight. For instance, when moving a heavy mold with an uneven bottom which distorts the skids, each of the spring-mounted rolls carries a safe load of about 800 pounds instead of two rolls being overloaded with almost the entire concentrated weight as was the case with solid supports.

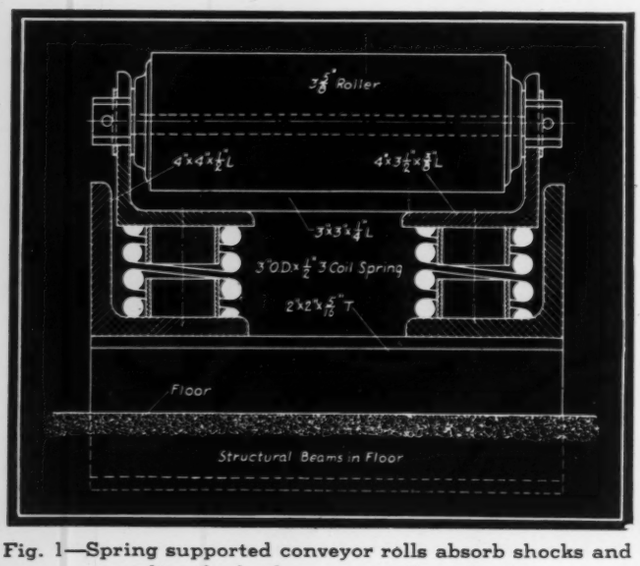


Fig. 1—Spring supported conveyor rolls absorb shocks and equalize the load over a number of units

Fig. 2—By eliminating sprocket hubs, single pass grinding between double disks became possible

Redesign Simplifies Manufacture

IN THE early days of the bicycle it was common practice to design the main sprocket as a forging with a hub on one or both sides. This was thought necessary for firm anchoring to the crank under the system then employed.

Later designs, especially those for the "one-piece" crank, successfully did away with the hubs. This not

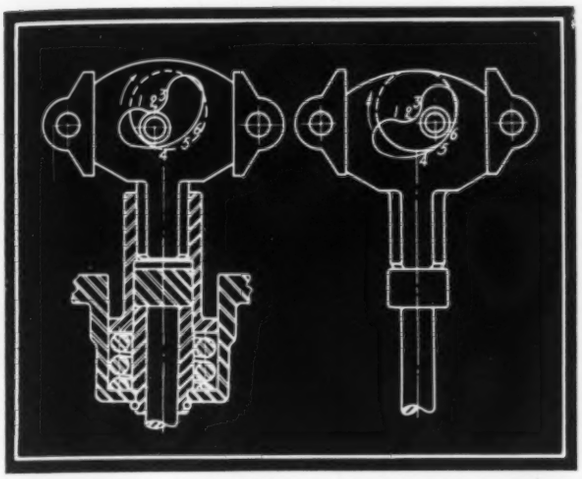


Fig. 3—Rotary motion is translated into hammer blows by curved slot in "free-thrown" plunger

only made possible the economy of a sprocket blanked from sheet steel, but also the further economy of finishing by flat grinding, as shown in *Fig.* 2. Held in a fixture, the sprockets, which have been straightened in a power press, are passed between the faces of two abrasive disks, thus grinding both sides at one operation.

Crank Generates Hammer Blows

TRANSLATION of continuous rotary motion into a true hammer blow is effected by means of a unique "free thrown" plunger in an electric hammer developed by the Stanley electrical tool division of the Stanley works.

The simple means by which this translation of motion is accomplished is illustrated by *Fig.* 3 which shows the beginning and end of the repetitive cycle —the diagram at the left being the beginning and that at the right, the end, the latter being at the moment of the actual hammer blow. Incidentally the cycle occurs 1900 to 2500 times per minute, depending on the size of the hammer.

The tool, which is held by hand, has much the appearance of the familiar electric drill, hand grip with trigger switch being attached to a longitudinal motor casing. A bevel pinion at the end of the motor shaft meshes with a bevel gear on a cross shaft which in turn carries the disk and crank shown.

The sliding member shown in the diagram, which can be called the hammer head, has a segmental cam slot in which the crank roller fits loosely. This slot is so located that the upstroke of the hammer head is caused by contact of the roller on the 2—1—2 surface of the slot. Rolling off the upper surface of the slot between 2 and 3, the roller jumps into contact with the lower side of the slot between 4 and 5 and gives the hammer head such momentum that it runs away from the roller during the last quarter turn of the disk. In other words, beyond contact point 6 the hammer is "free-thrown" against the spring-supported anvil block which transmits the blow to the chisel or other tool with which the hammer is equipped. At the instant of the actual blow, the roller is clear of both sides of the cam slot.

Welded Design Saves Material

WHEN designing for manufacture in large quantities, careful study of the design even of the simplest parts, from the production point of view, is of great importance. Not only is this important from the cost angle, but also from the quality angle. Frequently a less costly method of fabrication will result in a part as good or even better than a more expensive method.

A case in point is the detail shown at the upper part of *Fig.* 4. This is the hand grip for a valve seating tool and is 4¾ inches long with a 1¾-inch serrated head. This part could be designed for production in several ways, by screw machine, by cold heading or by spot welding, for instance.

Study of the problem in the light of the number to be made (which runs high into the thousands) and the equipment available in the shop, resulted in the selection of a two-part spot welded design, made by the method shown in the lower portion of the illustration. The stem is a screw machine job produced with minimum of machining, while the head—serrations and all—is a punch press job. By means of the simple fixture shown, the welding is done very rapidly and economically.

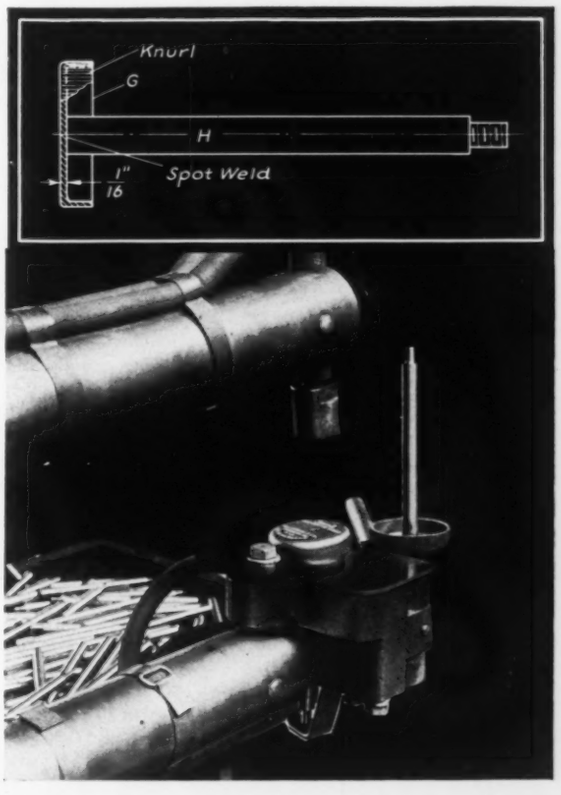


Fig. 4—By designing this part for spot welding, material required is reduced to minimum

Heat Treatment as It Affects

By Guy Hubbard

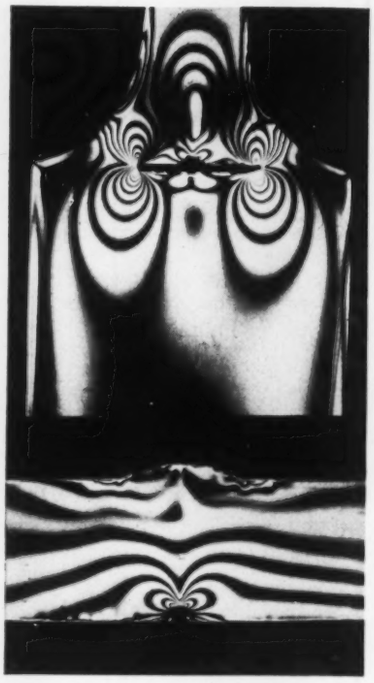


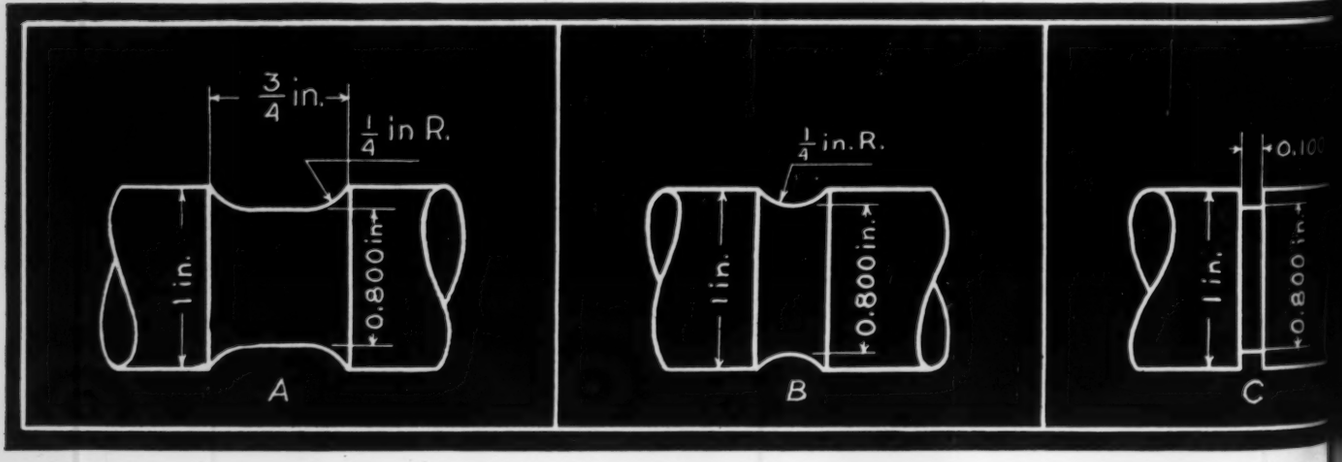
Fig. 1—Stress concentrations are revealed by transparent Bakelite models which are illuminated by polarized light while subject to service strains

NOT at all uncommon among machine designers is the belief that through heat treatment—hardening in particular—the stiffness of a steel part somehow can be greatly increased. As a matter of fact little or nothing in the way of stiffness can be added to a piece of steel by heat treatment. Assuming that the steel has been properly selected in the first place, the metallurgist can impart to it hardness to resist wear; toughness better to withstand the effects of and recover from tension, torsion and bending stresses (can improve its "springiness" in other words); and he also can relieve it of internal stresses which otherwise would impair its strength and cause it to go out of shape after machining. Its stiffness however is a structural problem which definitely is up to the designer.

Rigidity is only a relative term and designers today are inclined to think of their materials as stiff forms of jelly rather than as unyielding substances. With this in mind, Edward P. Burrell, late director of engineering of the Warner & Swasey Co., once remarked, "Complete elimination of deflection is of course an impossibility. Experiments by the bureau of standards have revealed that as light an object as a lead pencil causes deflection in a 3-inch bar 30-inches long."

Therefore, the right thinking designer will reduce the deflection to a practical minimum by scientific trussing and bracing, based on proper understanding and analysis of the stresses and their resulting deformations. Then with the help of a metallurgist he will select materials best suited to cope with the stresses. He will not however, expect the metallurgist to perform miracles in the way of "heat treating" into the structure stiffness that has not been "designed" into it.

Designers are now able to supplement their theoretical diagrams by actual visualizations of stresses, this by means of photoelastic models which—when subject to strains and viewed by polarized light—clearly indicate stress concentrations as darkened lines and areas. This effect is shown in a striking manner in *Fig.* 1, a group of two photographs of stressed transparent Bakelite models of sections of welds. For these interesting illustrations and their interpretation, MACHINE DESIGN is indebted to Everett Chapman, president of



...the Designer – Part II

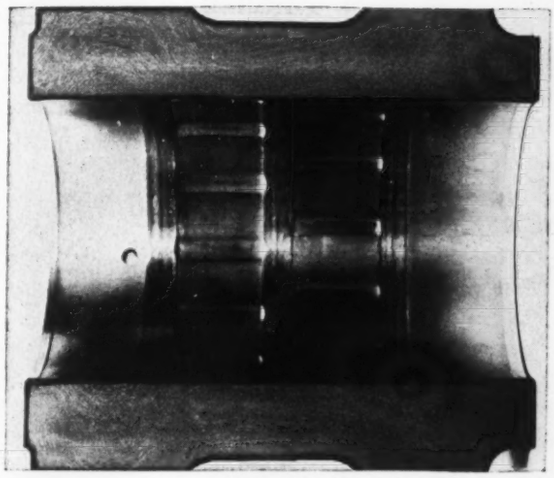


Fig. 2—"Brinelling", a breakdown of case by bumping of bearing rollers under shock load

Lukenweld, Inc. The lower photograph reveals the concentration of stresses at the root of a weld joining two plates, this welding having been carried on from the upper side only, leaving a notch at the opposite side which obviously is an open invitation to an early failure. The upper photograph demonstrates that in spite of generous double fillets, an internal flaw likewise causes concentrated stresses which will invite a fracture under axial load.

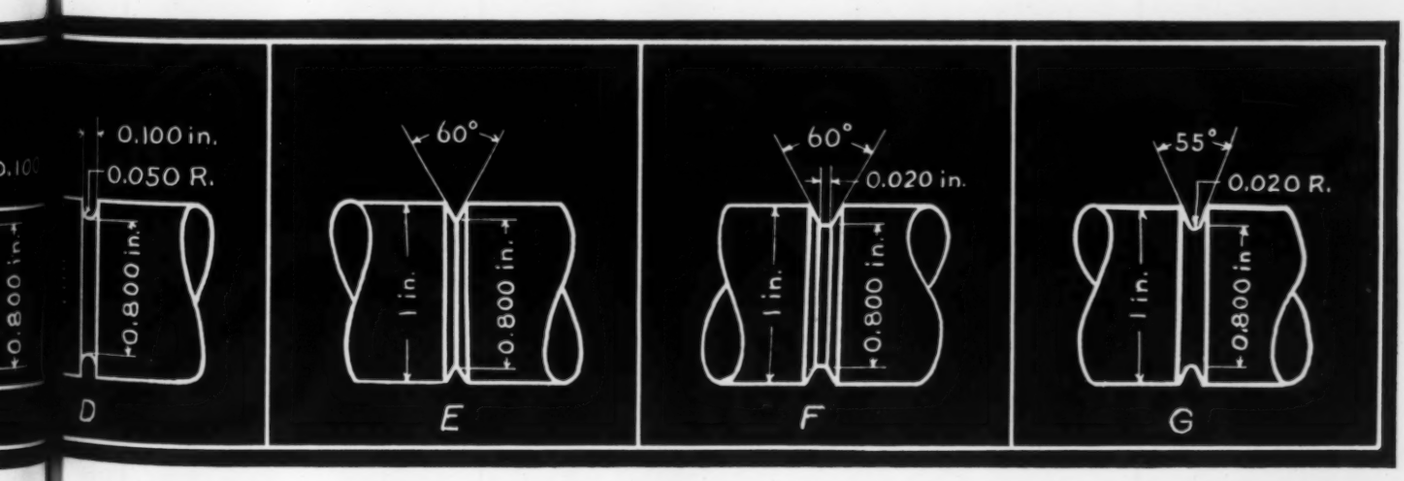
This brings up the subject of stress relieving, a technique in which the metallurgist can be of great service to the engineer. Many a well designed machine frame, either of cast or welded construction, has been roundly condemned as a failure because its internal stresses were not properly dealt with. These stresses, which might be called the "muscular aches and pains of metal parts" not only reduce ultimate strength but also cause the metal to "move" after machining, thereby throwing the machine out of line.

In the case either of a cast or welded part, an experienced metallurgist will be able to tell from drawings about what is likely to happen and very frequently can suggest modifications to eliminate causes of internal stresses. In any event, he will be able to recommend a normalizing treatment which will effectively release the stresses. And let us say here that it is highly important that the designer shall take cognizance of the size of the available normalizing furnaces before he designs his frames. Otherwise they may prove to be just too big to go in. Oftentimes two-part construction can be employed, thereby allow normalizing of large frames in furnaces of limited capacity.

The designer of welded frames should bear in mind that stress relieving also can be accomplished by hammering as well as by the furnace method. An operator who is experienced in the technique can go over a welded structure with a pneumatic or electric hammer and by thoroughly peening the welds and welded members can bring the structure into line and make it stay in line. This is not heat treating but the end result is very much the same, therefore it deserves to be mentioned.

Relation between case and core is very important, especially in parts subject to concentrated, intermittent loads. In this connection the bearing ring shown in *Fig.* 2 illustrates a phenomenon called "brinelling". It is much more common than is generally supposed, although not ordinarily to such an extreme degree as this. As the name implies, "brinelling" is due to rhythmic "bumping" of a roller or ball bearing, caused

Fig. 3 — Specimens employed by Forrest F. Johnson in his rotating fatigue tests to determine effect of necks of various shapes on life of shafts



by a repetitive shock load such as may occur on the crank shaft of an engine. If the original carburized case on the ring is too thin; if it was too greatly reduced in finish grinding; if it subsequently has worn down because of faulty lubrication; if it is too soft; or if the core metal below the carburized case is too soft to give proper support; indentation of the case by the rollers or balls will result.

In the first article of this series considerable emphasis was laid upon proper shaping of parts to avoid fracture-inducing points—called in the language of the metallurgist, "stress-raisers". Authoritative data on the effect of "stress-raisers" of various kinds, were obtained by Forrest F. Johnson through actual experiments in the laboratories of the Spencer Mfg. Co. With the kind permission of the editors of *Automotive Industries,* in which journal the results were published, we reproduce as *Fig.* 3 diagrams of Mr. Johnson's test pieces, together with the following comments.

The specimens were of SAE 3140 steel, heat treated in the usual manner; drawn to 321 Brinell; turned, then ground, to 1-inch diameter; and finally "necked" in the center as shown in views *A, B, C, D, E, F* and *G* of *Fig.* 3. The pieces were run on a rotating beam fatigue-testing machine of Farmer or Wohler type under surface stress of 77,000 pounds per square inch at their minimum diameter. Before ultimate fracture, specimen *A* showed life value of 81,000 revolutions; *B,* 75,400 revolutions; *C,* 19,000 revolutions; *D,* 14,500 revolutions; *E,* 13,530 revolutions; *F,* 13,800 revolutions; and *G,* 12,650 revolutions.

One of the most significant points is that the specimen shown in *C* of *Fig.* 3, which has a square neck, showed 24 per cent greater endurance than *D* which has a radial groove. Although *C* has two sharp corners which would seem to be typical "stress raisers", the square neck actually does afford better distribution of stress than does the radial groove. In the latter case the stresses are concentrated within a small width at the bottom of the radial groove, whereas in the former they play over the full .100-inch width of the groove. This does not mean that a sharp corner is better than a fillet but it does emphasize that the designer should aim always to distribute stresses as much as possible.

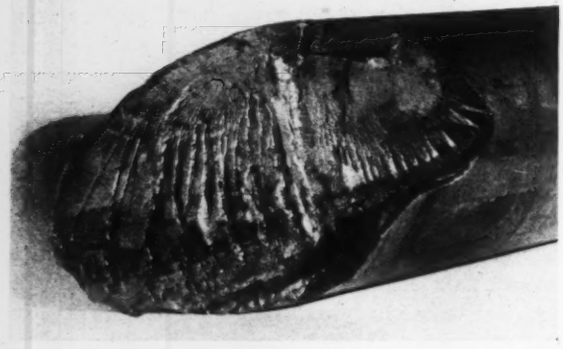
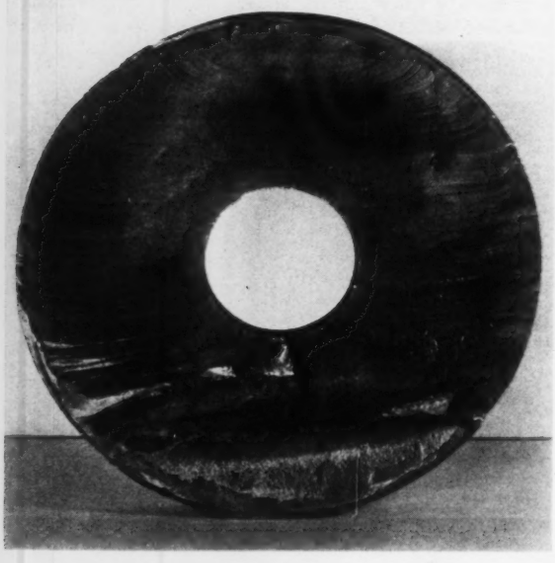


Fig. 4—Above—Failure of this shaft started with stress concentration at corners of keyway

Fig. 5—Below—Section of large hollow drive shaft showing fracture induced by deep tool mark



Examples of Fatigue Failures

Study of fatigue failures of steel parts in actual service often will indicate clearly the cause of failure which—if due to design—can be eliminated by relatively minor changes on the drawings. An instance is that depicted in *Fig.* 4, which is of a fractured power drive shaft. The keyway where the fracture originated is a "necessary evil" in this case, but in later designs it has been found that fillets of small radius in the corners reduce stress concentrations without interfering with the purpose of the keyway.

The hollow shaft shown in *Fig.* 5 demonstrates a fracture which originated with a deep tool mark. The importance of smoothly turned, or better yet—ground—finish on high stressed shafts cannot be too strongly emphasized. Not only are tool marks and deep scratches dangerous stress-raisers in themselves but they also invite corrosion which further and very rapidly impairs the strength. Designers should take into account this matter of corrosion, not only as regards disfigurement and rapid wasting away of a part, but also as one of the most dangerous strength impairing factors.

This and the first article of this series have been written more particularly from the viewpoint of the engineering department. They are from the angle of the designer seeking the answer to the question, "How can the engineering dpartment work with the heat treating department to the end that parts will be right not only on the surface but all the way through." The next article, for May, will approach this problem from the opposite direction. It will be written by Lewis F. Herron of the James H. Herron Co., Cleveland. As metallurgist of this well known consulting organization, Mr. Herron has had wide experience in solving metallurgical problems of machinery builders in many lines. His advice to designers will be based on that experience.

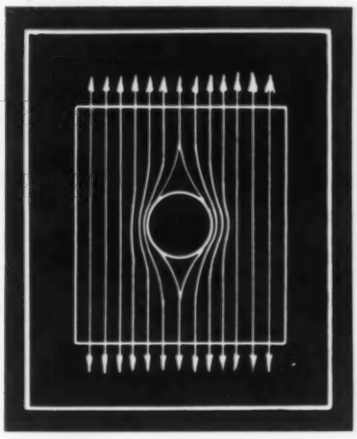


Fig. 1 — Direction of stress plotted around a circular hole

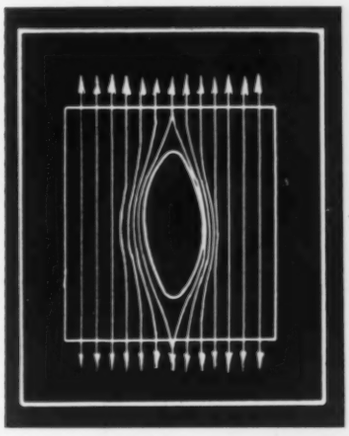
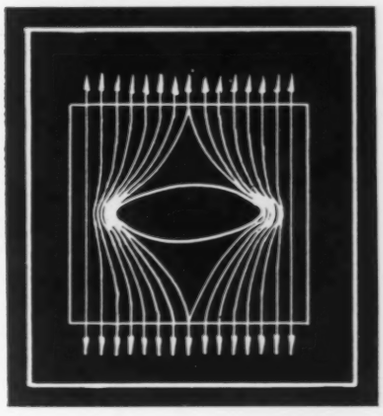


Fig. 2—Flattened cross section permits greater area and better stress distribution

Aerodynamic Theory Used in Analysis of Stresses

By D. L. Pellett

Fig. 3 — Obstruction at right angles to stress flow creates serious stress concentrations



SOME of our problems as machine designers would be much simpler if we could substantiate a stress analysis by measuring and studying the distribution of a tangible substance. Our efforts are hampered by the lack of a convenient "stress meter," a device that would enable us to check the design of machine elements having an uncertain stress distribution. Strain gages may be used to study certain types of structures, photoelastic tests are invaluable for many cases, but neither of these methods is commonly available for the solution of routine problems. Dozens of questions demand daily answers: Do we need a fillet here—what is the optimum frame contour—would an opening affect the part's strength? Questions of this nature can seldom receive a precise, mathematical solution. Any plan should be welcome that will enable us to form a mental picture of stress patterns.

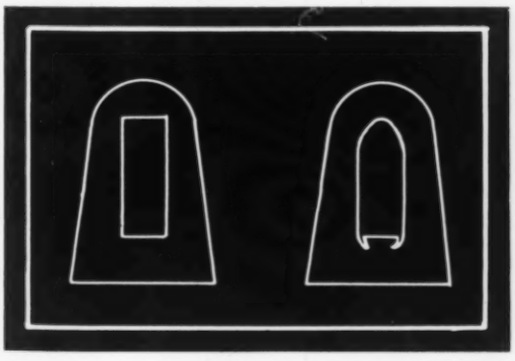


Fig. 4—Streamlined effect in opening in frame relieves stressed areas

An interesting analogy offers a qualitative solution for certain types of stress analysis problems. This relationship enables us to use aerodynamic flow conceptions as an aid in the design of stressed machine elements. Mathematical and photoelastic studies have shown that the lines of principal stress in a loaded mem-

ber bear a definite similarity to the flow lines used in aerodynamic studies. This relationship suggests that we visualize principal stress lines as "stress flow lines" having the characteristics of air flow lines. These flow lines will tend to follow the shortest path around an obstruction: A convergence of lines near an obstruction will indicate an increase in pressure for air, and an increase in stress for an elastic body. Obviously this is not a theory stated with handbook preciseness, it is a thought habit, a mental device that makes stress distribution less abstract.

The familiar problem of a small hole drilled in a relatively large plate can serve as a convenient example. Considering the hole as an obstruction to stress flow, we can plot the probable direction of stress travel. The resulting sketch in *Fig.* 1 indicates the "packing" of lines as the flow is deflected around the obstruction. This packing indicates stress concentration, an assumption verified by photoelastic studies telling us that the stress concentration factor is three. *Fig.* 1 suggests that we consider the probable flow about a streamlined obstruction such as the opening in the plate of *Fig.* 2. We find that the flow congestion obtained with a round hole has been relieved by "streamlining" the opening, our new lines having a minimum of slope variation and a greatly reduced stress concentration. These findings enable us to evolve a correct shape, practical in many cases, for hand holes or web openings; perhaps even certain types of pins and rivets should have this flattened cross section. The opening of *Fig.* 2 can have a greater area and a much more favorable stress distribution than our original circle.

If we place the obstructing opening of *Fig.* 2 at right angles to the direction of stress flow we obtain the pattern shown in *Fig.* 3. The drastic slope changes at the ends of the opening indicate serious stress concentrations at these points. These concentrations are virtually independent of the plate width and the size of the opening. Failures due to minute fatigue cracks, small slag inclusions, and machine marks, can be traced to an effect of this nature.

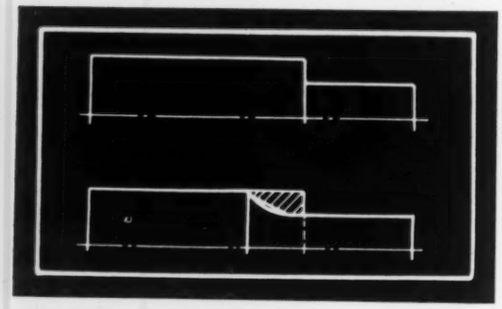


Fig. 5—False framework is used in aeronautical design to streamline structural members. An analogy, as it applies to a square-shouldered shaft, is shown above

Many types of machine frames can be improved with the aid of "stress flow lines." The "streamlined" opening in the roll housing of *Fig.* 4 has relieved the stress concentrations existing in the elementary housing shown at the left. The curved slots eliminate stressed areas while retaining the rectangular opening shape.

Aeronautical designers have found it advisable to "fair out" structural members to a streamlined shape by using a false framework. Our flow analogy suggests a similar application. The square shaft shoulder in *Fig.* 5 can be improved by a false collar pressed in place, as shown at the bottom of the sketch. *Fig.* 6 illustrates another example of fairing with the use of a false block which improves stress distribution.

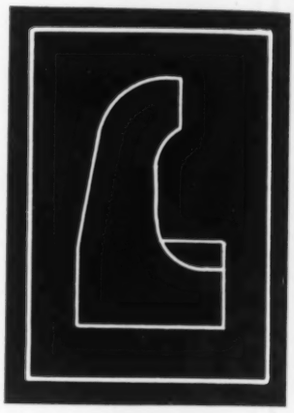


Fig. 6—False block and "fairing" as utilized for the frame of heavy press

Current design trends seem to follow two paths, as seen in the strictly functional devices built as production equipment and the nicely molded products sold to the consumer. A true conception of stress distribution should enable a designer to develop a machine that is strictly functional but shaped by sales appealing curves.

Synthetic Rubber Finds New Use

OIL-PROOF, synthetic rubber recently enabled the manufacturer of the world's largest automatic weighing scale to give an unconditional guarantee on parts usually affected by gasoline and oil. The large scale weighs 27,000 pounds of gasoline and oil each minute and to convey and weigh this amount accurately, it is necessary to use a 12-inch flexible hose. After test operation the hose remained flexible and gasoline proof. Any resistance to the delicate movement of the weighing tanks mounted on the scale levers to which the hose is connected would seriously affect the accuracy of the scale. Instantaneous stoppage of the liquid flow at exactly the proper moment is accomplished by the use of the synthetic rubber for the valve seat disks. Tests revealed that the scale registered an error of less than 1/900 of one per cent, an unparalleled mark of accuracy for such a large unit.

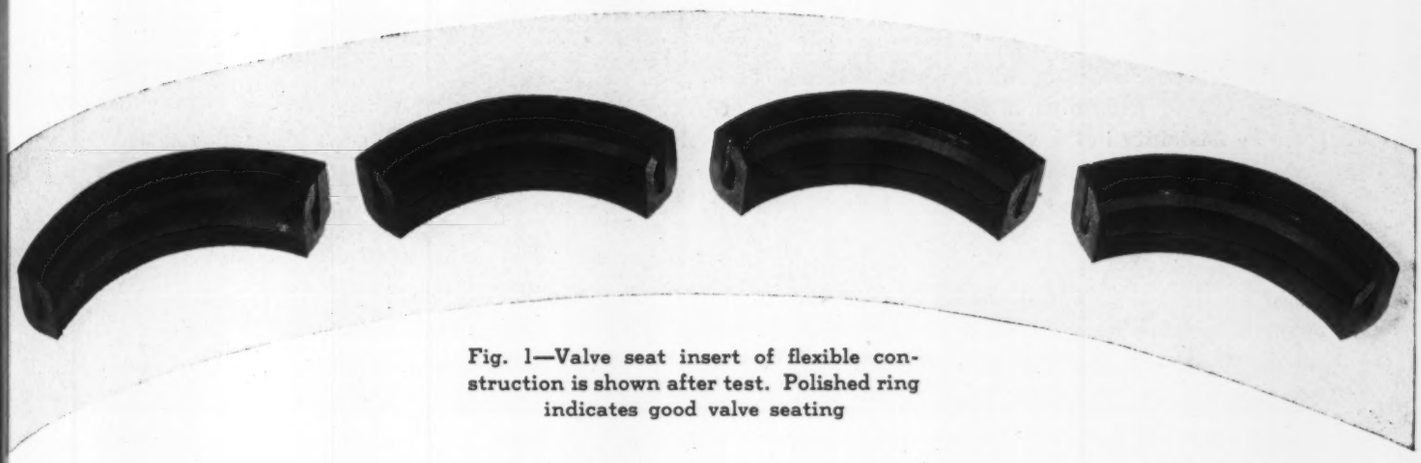


Fig. 1—Valve seat insert of flexible construction is shown after test. Polished ring indicates good valve seating

Distortion Reduced by Use of Flexible Valve Seats

By S. D. Heron and A. L. Beall

VALVE seat distortion and consequent valve leakage is one of the major causes of exhaust valve burning in aircraft engines of high output. In cylinder designs sensibly free from valve seat distortion, a high degree of exhaust valve durability is secured with relative ease by the application of modern exhaust valve practice. Some cylinder designs are attractive due to compactness and ease of securing large valve area but are known to be sub-

THOUGH aircooled cylinders are more prone to distortion than watercooled types, similar problems in exhaust valve leakage are shared by both. The use of flexible exhaust valve seat inserts in an aircooled cylinder head, as described in this article, might well be applied to other types of cylinder design. The article was presented as a paper last month at the National Aeronautic meeting of the SAE. Mr. Heron is associated with the Ethyl Gasoline Corp. and Mr. Beall with the Wright Aeronautical Corp.

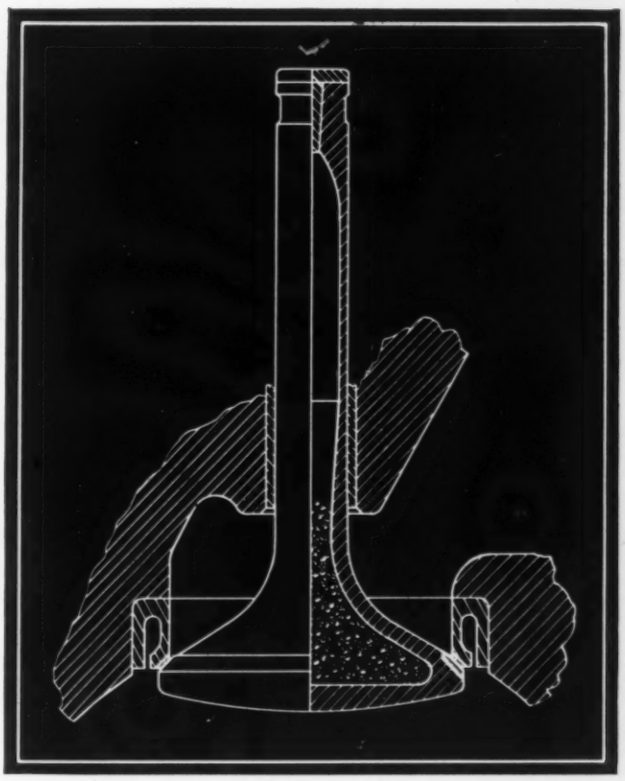


Fig. 2—Valve is designed for maximum cooling via the stem in this arrangement with a flexible insert

ject to exhaust valve seat distortion.

In view of the difficulties and limitations resulting from such distortion, an investigation has been carried out to determine if its effects can be overcome by flexibility in the valve head or valve seat.

Design studies of flexible valves and inserts were made four years ago as a result of investigation of a chronic case of valve seat distortion. In this case a considerable reduction in valve temperature produced by the use of a well-cooled, hollow-head valve, resulted in more rapid valve seat guttering than occurred when valves with hotter and less rigid heads were used. It was apparent that the red hot zone in the hotter valve design gave sufficient plasticity to enable the valve to conform more readily to the distorted cylinder head.

Studies of valve heads with considerable radial flexibility, such as the deep tulip type used in British engines of the war period, led to the conclusion that with such designs adequate cooling could not be secured at high output per valve. The use of a valve with a rigid head, in combination with flexibility of the cylinder head at the point where the valve seated, was studied and this seemed to be subject to fewer limitations than the flexible valve head. It appeared that if sufficient radial flexibility could be secured at the seating surface in the cylinder, a 45-degree valve could probably be relied upon to produce a tight seal by its wedging action. Several designs embodying such a mode of sealing have been worked out and are shown in *Figs.* 2 and 4. In these designs an attempt is made to obtain flexibility of the valve seat

Fig. 3—This valve if used with solid insert under the test conditions would show evidence of leakage

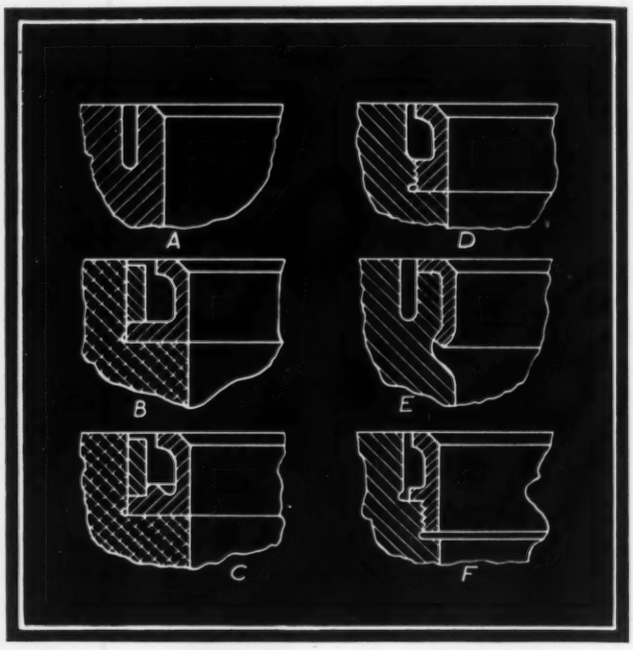


Fig. 4—Various types of flexible valve seat construction are shown in these diagrams

up to the point where conformation between valve and seat occurs. The wedging action producing conformation requires axial movement of the valve, produced by the valve spring or gas pressure on the head of the valve. As soon as the cylinder seating surface has been forced into conformation with the valve, axial movement of the valve with relation to the seat will cease. After a complete fit between the valve and seat has been secured, slight lateral movement of the valve head and its seating surface in the insert, relative to the cylinder head as a whole is possible. Gas pressure in the groove in the insert may play its part in forcing the seating surface into tight contact with the seating face of the valve.

An insert of the type shown by B in *Fig.* 1 was tested in an iron cylinder. The insert material was SAE 4140 steel and this was apparently unsuitable since the seating portion split after a few hours running.

Cyclone Cylinder Is Used

Since the design and material used in the first test were open to doubt it was decided to conduct a second test in which no limitations should be set by fabrication cost. An experimental model Cyclone cylinder (6⅛ inch bore and 202 cubic inch capacity) was chosen for test. This particular cylinder model was never developed beyond the experimental stage because it suffered from exhaust valve seat distortion when subject to detonation and overheating. The capacity and output of the cylinder seemed appropriate for the test, since experience indicated that a flexible valve would operate at an excessive temperature.

The seat insert and exhaust valve arrangement shown in *Fig.* 2 was adopted in which arrangement

the valve is designed for maximum cooling via the stem with the intention that the insert shall, as far as possible, be limited to the functions of supporting and sealing the valve. The insert material is austenitic nickel-chromium valve steel, and both valve and insert are faced with stellite. Thirty hours of testing, including 15 hours under conditions of detonation and overheating, has been carried out. The condition of the exhaust valve and insert after test is shown in *Figs.* 1 and 3. Lack of significant leakage as evidenced by a continuous polished ring on both seating faces may be noted. The seat on the valve is considerably wider than the seating face of the insert, and consequently the complete width of the seat face shown in *Fig.* 3 is not polished. With similar conditions of detonation, over-heating and limited duration of test, a solid insert in the same type of cylinder shows definite evidence of valve leakage in the form of low patches on the seating face.

Testing has been too limited to permit evaluation of mechanical reliability, or other characteristics, but there is reason to believe that mechanical difficulties which may develop will be easier to overcome than valve burning due to seat leakage. The test results indicate that the heat conducting capacity of the cylinder in the immediate vicinity of the exhaust valve seat may be less important than it is now generally considered to be.

It is believed that further work with flexible valve seats may remove certain present limitations on cylinder design which are the result of distortion produced by both temperature and pressure variations.

Specification Writer Faces Constant Changes

By John F. Hardecker

TO MANY of those engaged in engineering or procurement work specifications merely represent a number such as a telephone number—you dial or express the number and you get what you want. Like the telephone number, under normal circumstances, that's all there is and should be to it, but, if and when the specification is not a good specification, you get "line trouble" in the form of protests from contractors whose material is being rejected, and from scheduled users of the material whose work is being held up for lack of delivery; kicks come also from users who find that the material, although conforming to the specification, is not suitable for the purpose intended—the whole building up a chain of interlocking ramifications that are decidedly serious to all concerned. Thus, the quality of the specification affects everyone, including the material supplier, the designer, the test laboratory and the user. Therefore it would appear that all that is needed are good specifications, and that is true; but good specifications, in turn, require an intimate and broad experience in specification writing.

Cannot Depend on Intangibles

Specification writing, at first glance, would appear as one of the simplest forms of engineering practice—the mere recording of a series of facts concerning a particular material or product, in a more or less logical sequence. The facts, however, require something more than mere sales literature as their basis, for they in turn must be defined within reasonable limits and in terms of specific test procedures without too much dependence on intangible adjectives and adverbs.

Must Follow Logical Practice

Sometimes the "facts" become mere "desires," idealistic in their conception and impractical in their attainment, as in the case of a specification for a compound which required that the material was to be of such a nature that upon immersion of a painted part in it, the part was to be cleaned in a period up to one hour's immersion; after one hour it was to be stripped of its paint. The convenience of this cleaning compound cannot be denied, but the idea that until the alarm clock went off at the end of an hour the chemicals would politely refrain from attacking the paint finish, but that after the alarm they would fall to with a will was truly fantastic.

Likewise, there exists at times an unfortunate tendency to "combine the best features" of several known or tested products into a single product by the mere writing of a specification saying it shall be so, without first verifying in the laboratory or production shop that it can actually be made to do so. This leads to the inopportune bursting of the dream bubble at the most inopportune time.

Specifications for products, particularly where there

is a range of sizes, may be based on inadequate original test data and improper interpretation and interpolation for the complete size range, as in the case of a specification for Bakelite pulleys with inserted ball bearings which required that the bond of the outer race in the pulley must withstand a shear load of 200 pounds. When this was evaluated in terms of a uniform loading taking the bond area into consideration, it ranged from 314 pounds per square inch for the smallest pulley and bearing to 80 pounds per square inch for the largest—an obviously incorrectly stated requirement.

Complexity Demands More Specifications

This matter of specification writing for component materials grows more precise as the unit or product ultimately to be manufactured becomes more and more a matter of complexity and mass production, reaching its zenith in such products as automobiles and airplanes. Under such circumstances, the various materials must not only be painstakingly chosen, but they must be procured on open competitive purchase with adequate inspection, which means specifications rigid enough to assure highest quality but at the same time flexible enough to secure the greatest qualified competitive bidding.

To prepare such specifications often entails the need for a greater and a broader knowledge of a particular industry on the part of the specification writer than that possessed by the specialists and technicians whom he contacts—for those specialists while intimately acquainted with their own company material for a particular purpose are entirely without detail knowledge of competing products designed for the same general purpose. Then, too, in the interest of inspection and test economy, test procedures must be standardized for the same class of products, although vendors may each have their own particular method of testing and units by which they record their results.

Specifications Should Be Standard

For example, the paint industry uses about a dozen different test procedures for evaluating viscosity, each in a system of units peculiar to the method. A proper purchase specification should permit the use of several methods but limit the reporting of results to a single unit, poises absolute, and specify a single check test method for all inspection purposes. Experts often lose sight of the fact that conditions which they regard as routine in their own laboratories and therefore not necessary of expression in defining a test procedure, often are the controlling factors in the duplication of test results, as in the case of a specification for a rust preventive compound, where unexpressed temperature and humidity, finish and grade of steel panels, and type and pressure of spray gun used in applying the salt test solution, were all significant factors which in not being defined, prevented the duplication of results between different testing agencies.

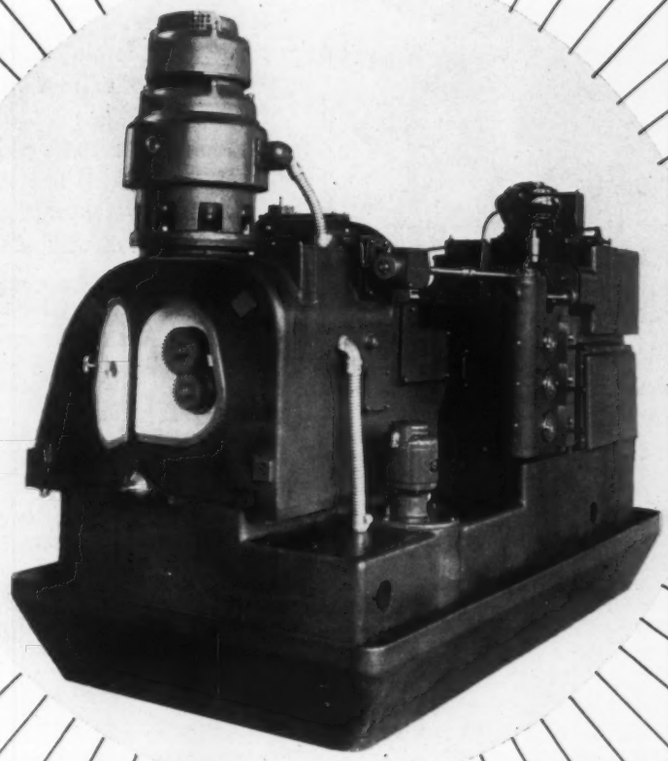
Writer Must Be Alert For Changes

The specification writer must ever be on the alert for the changing effects of production practices upon the material defined by his specification, while at the same time holding the number of routine tests required for inspection purposes to the minimum in the interest of economy. There was an instance in a specification for silk for mechanical use, permitting originally both twill and plain weave, and including a thread slippage requirement, where it was observed that the plain weave never failed slippage, while the twill frequently did. Therefore it was decided, not without logic, to restrict the weave to plain weave alone, and eliminate the slippage requirement. This worked for a number of years until a new manufacturer in the field, by what was presumed to be a slight difference in manufacturing technique, produced and delivered a plain weave which met all the specification requirements, but which had excessive thread slippage, and the limitation of thread slippage was no longer a specification requirement.

It must not of course be assumed, from the nature of the examples here recorded, that the life of the specification writer is a continual battle against the world and its desires to slip something over on him. On the contrary, he enjoys the whole-hearted cooperation of the many highly trained and efficient technicians of the various testing laboratories, of the shop foremen and supervisors when his specification is a matter of process on application, and of the many technical experts employed by the material concerns whose products it is desired to purchase by fair and open competition under a specification.

Electric Eye Foils Marauders

BURGLARS hardly have a chance against a new development in the electric eye made recently by the General Electric Co. The protectional device relies principally on the phototube to foil marauders. A beam from a standard automobile headlight bulb, from which all visible rays of the light spectrum have been filtered, is the nucleus of the device. By a multiple system of mirrors, this single invisible beam is reflected back and forth across a room, around corners, and at different levels and angles until the guarded area is completely protected against the movement of a body in any direction.



Built-in Drives Improve Machine Efficiency

By Stanley T. Goss
President, The Goss & deLeeuw Machine Co.

NO LONGER is the question raised: Will the machine work, but rather: How well will it work?

Every effort is made by designers now to raise the efficiency of a machine. Ingenious applications are made of conventional parts for new functions to increase production capacity, and it is in this endeavor we find interesting new designs in many types of machines. Machine tool builders have striven to make their products efficient. The fact that a dozen machining operations can take place simultaneously in one machine attests to their success.

To attain high production with economy the proper selection and utilization of drives in a machine are two of the most important phases of design. The incorporating of prime movers into a machine as a means of saving space and making the machine more flexible is a modern trend. A machine in which maximum production with accuracy and economy are attained by the use of special motors for driving as well as for high speed chucking and unchucking is the Goss & deLeeuw Machine Company's automatic, rotating, five spindle chucking machine shown on this page and in *Fig. 2.*

Eight electric motors are used in this machine, three for driving purposes and five for operating the chuck jaws on each of the five spindles. All of the motors are built in to the machine and are made specifically for the function that they perform. One large motor drives the five spindles directly through a worm reduction and spur gears. The main tool slide, the cross slides and the indexing of the spindle carrying cylin-

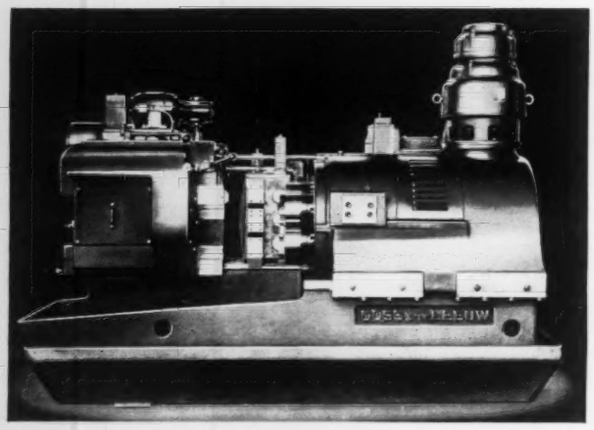


Fig. 2—Front view of automatic chucking machine shows the compactness obtained by the use of built-in driving motors

der are controlled by a small gearmotor which runs continuously. The third driving motor is directly connected to a high speed centrifugal pump which circulates the coolant.

In this class of machine it is necessary to stop the spindle while it is in the loading position to allow the operator to remove the finished piece and insert a rough piece in the chuck or holding fixture. Naturally this cannot be done while the chuck is revolving and the method of starting and stopping the spindle is of interest on this machine. A 10, 15 or 20-horsepower motor drives the five chuck spindles through change gears and a worm reduction. The illustration on the first page shows the large driving motor mounted on the machine. The two gears shown in the opened case may be changed to obtain the correct spindle speed for the job on hand. Each spindle is driven by a large tooth or dog clutch which can be seen in the drawings, *Figs.* 3 and 4.

With the spindle clutch engaged and the drive motor running, the spindle revolves at cutting speed. When the clutch is out of engagement the spindle stops whether the motor is running or not. The spindle drive motor is started and stopped during each cycle by a switch controlled by the forward and backward motion of the tool slide. As the slide moves forward the switch is closed and the motor is started, driving the spindles on which the clutches are engaged. As soon as machining operations are completed the tool slide returns, opening the contact switch and stopping the drive motor. A built-in brake is a feature of the motor. It causes the armature and connected moving parts to stop almost instantly when the power is cut off, thus reducing the chance of spiral scores on the work, which does not revolve as the tools withdraw. Also, with this design the spindle clutches do not revolve when the tool slide is back and the machine is ready to index.

Each spindle clutch is held in engagement by a heavy coil spring as shown in *Fig.* 4, and is fitted with a pull rod and cam roller. In the loading and unloading position a cam actuates the roller which disengages the clutch through the pull rod and allows the spindle to stop. Cams may be so placed that one or more spindles will stop in any position desired. When the spindle cylinder indexes out of the loading position, the roller leaves the cam and the clutch is thrown into engagement by the loaded spring. If the tool slide is feeding ahead, all spindles are turning with the exception of the one in the loading position. When the slide is back, the spindles are not turning and the clutch, which has been disengaged, slips into place with the indexing movement of the cylinder without noise or jar. The action is the same whether the machine is set up for a speed of 50 or 625 RPM spindle speeds.

Automatic chucking has usually been accomplished by either hydraulic or pneumatic means. In the Goss

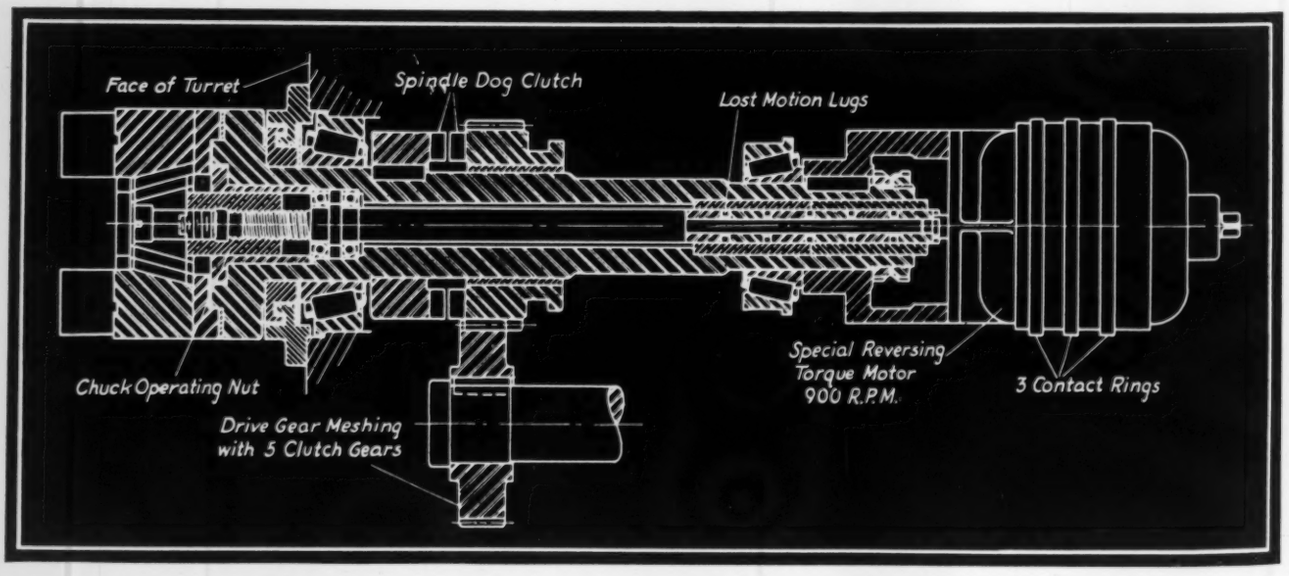

Face of Turret
Spindle Dog Clutch
Lost Motion Lugs
Special Reversing Torque Motor 900 R.P.M.
3 Contact Rings
Chuck Operating Nut
Drive Gear Meshing with 5 Clutch Gears

Fig. 3—Cross section of single work spindle with chucking motor is shown here. Details of nut and screw which produce wedging action to operate chuck jaws are shown at the left of the drawing

& deLeeuw machine a unique method has been devised which does not require the attachment of pipes or air lines for the chucking operation. Electric motors ordinarily used for driving applications find a new field here in which their use has been highly successful.

On the end of each work spindle a reversing 900 RPM chucking motor is mounted, having a torque of six foot-pounds. The motors can be seen in *Fig.* 5 and a schematic diagram of their operation is shown in *Fig.* 3. These motors are of the flange type and are mounted as a conventional air cylinder would be. Around the housing of these motors are three continuous contact rings insulated from the motor body, but each connected to one lead-in wire of the motor.

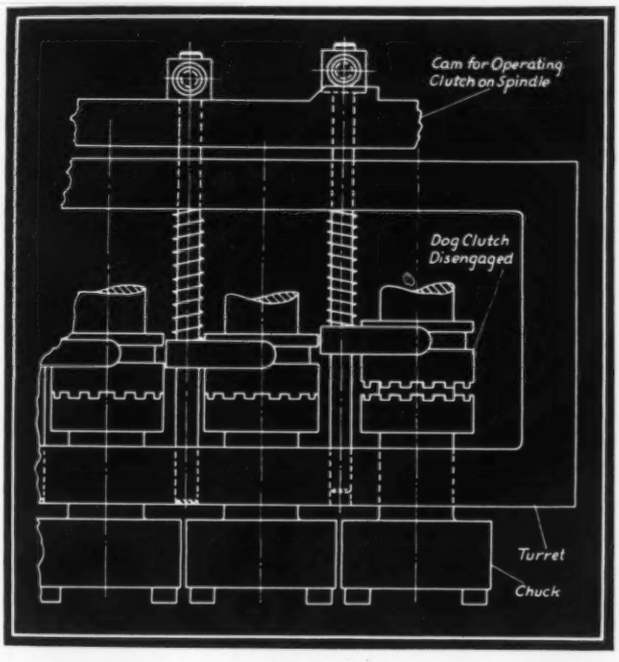


Fig. 4—Separate dog clutches for each work spindle permit one to be stopped while the others rotate

Electricity is supplied to the motors, one at a time, as they move into the loading position during the indexing operation through three contact fingers which can be seen in *Fig.* 5. The rings being continuous, they insure contact being made in whatever position the spindle stops in relation to the cylinder of the machine. The four motors in the working positions are dead as they are not in contact with the fingers.

A chuck and unchuck pushbutton is located on the machine convenient to the operator. The motor runs in either direction according to the button that is pushed. Holes are drilled through the spindles and in the holes are a number of lost motion driving lugs, *Fig.* 3, which allow the motor to make about three revolutions before any load is placed on it. In this manner the motor is able to get up to speed and develop full torque before the load is applied. At the forward end of the spindle, just behind the chuck, is a screw and nut, *Fig.* 3. The nut slides in the ground

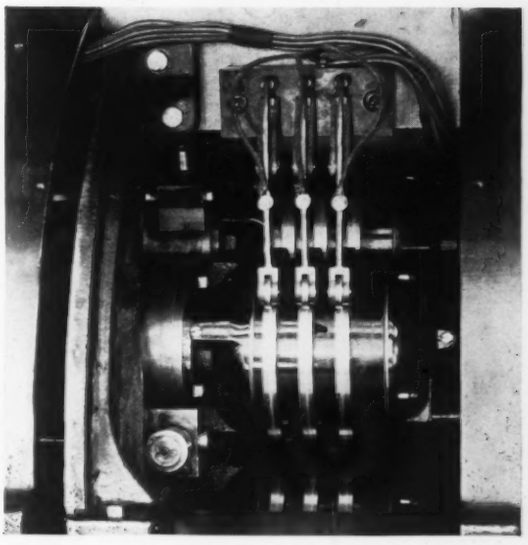


Fig. 5—Electrical contact fingers supply power to motor as the spindle and chuck unit moves into loading position

bore of the spindle and is held from revolving. The screw is directly connected through the lost motion lugs to the motor shaft, and the chuck mechanism is connected to the sliding nut which acts in the same manner as a draw bar. Resistance can be placed in the electrical circuit of the chucking motors to obtain any degree of pressure.

The feed and index drive on the machine is through the separate 3-horsepower motor with a 7½ to 1 worm reduction. The motor runs constantly and transmits power to the cross slides through a straight shaft. Another power takeoff runs the main tool slide. The cam for operating it is shown in *Fig.* 6. A direct motor driven centrifugal pump is provided with a maximum capacity of 60 gallons of coolant per minute.

The use of five electric motors which make only a few revolutions for each cycle of operation might seem extravagant. Yet the increased efficiency of the machine as a whole proves that the seconds saved in the chucking and unchucking operation warrant their use.

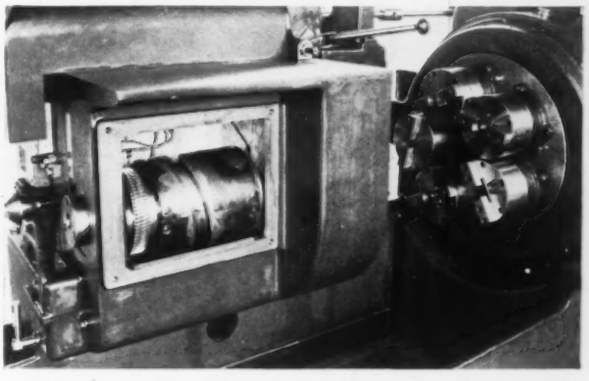
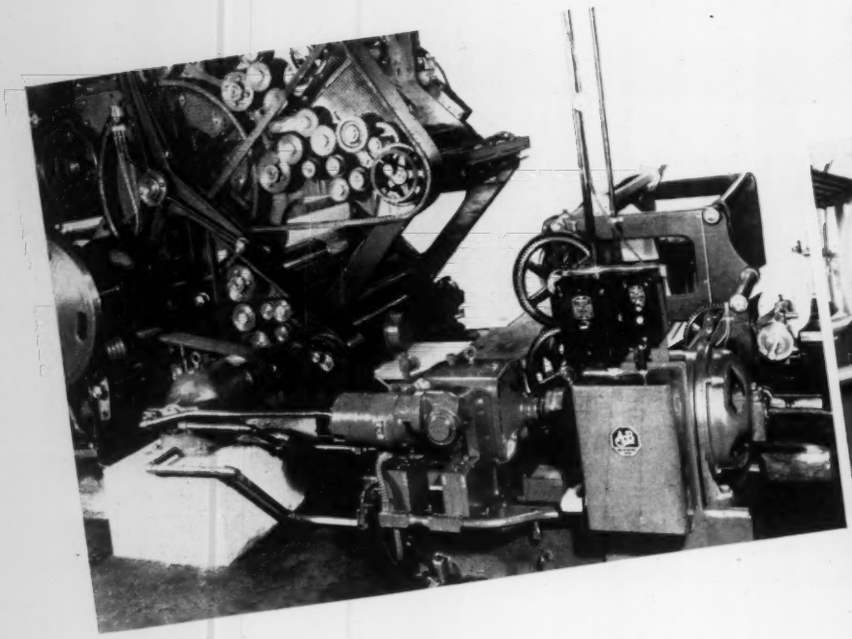


Fig. 6—Cam for operating main tool slide is easily accessible for adjustments

By Fred Kelly

Variable Speed Drives Aid Mach



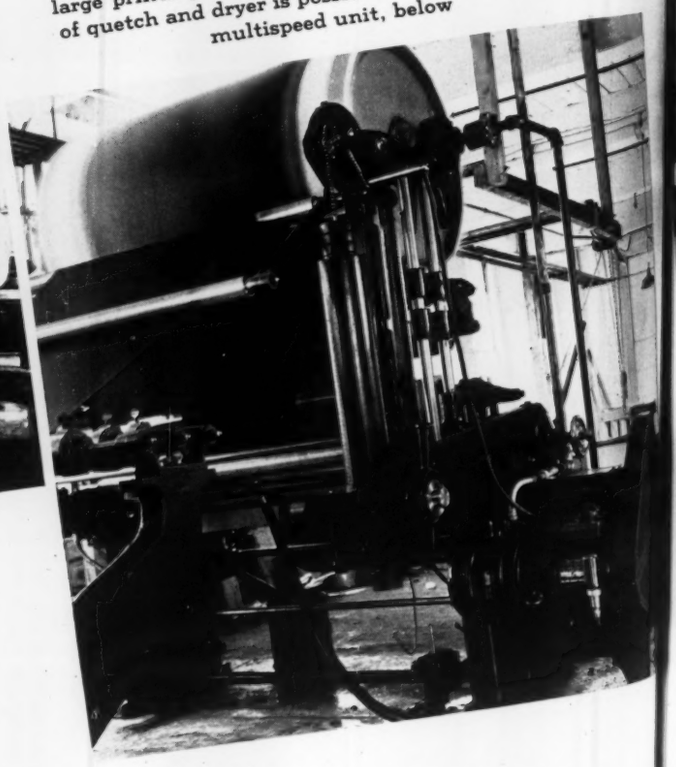


Fig. 1—Hydraulic drive provides variable speed for large printing press, left. Fig. 2—Synchronization of quetch and dryer is possible with dancer roll and multispeed unit, below

SPEED control in modern industry, from regulation of automobile production line travel to timing of a bread oven conveyor, is of unquestioned importance. One unit unsynchronized in a battery of machines, each dependent on the other, can throw an entire department out of kilter. Cost and quality of production are vitally affected by correct timing of machines and speeds too fast or too slow hamper otherwise efficient operation.

Different conditions influence the operation of individual machines. Such factors as variance in temperature or atmospheric conditions, size and shape of products made in the same machine, peripheral speed of material wound up during manufacturing operation, and a variance in skill or number of machine operators must all be compensated for by speed control. Infinite variable speed control must be used to obtain the many exact speeds which variable operating conditions demand.

Machine designers and plant managers fortunately recognize the advantages which variable speed control gives in the operation of an individual machine or a related group of machines. Hundreds of machines are equipped with change speed units now as original equipment and the units have been installed on many more in operation to give them complete flexibility of control. The increasing tempo of business in all lines is causing engineers to apply these units on machines which in the past received their speed control in steps or jumps. This method was adequate as long as the dependency of one machine on another was not so acute as it is today.

Mechanical conditions in different machines have resulted in the development of several types of variable speed transmissions. Recently units combining the prime mover with the transmission have been developed and are particularly adaptable for certain drives. Those transmissions in which the input and output shafts are in line have proved well suited to compact drives. Hydraulic variable speed units consisting of a hydraulic pump and motor, either as a single unit or connected by pipes, have long been popu-

ac ne Operation

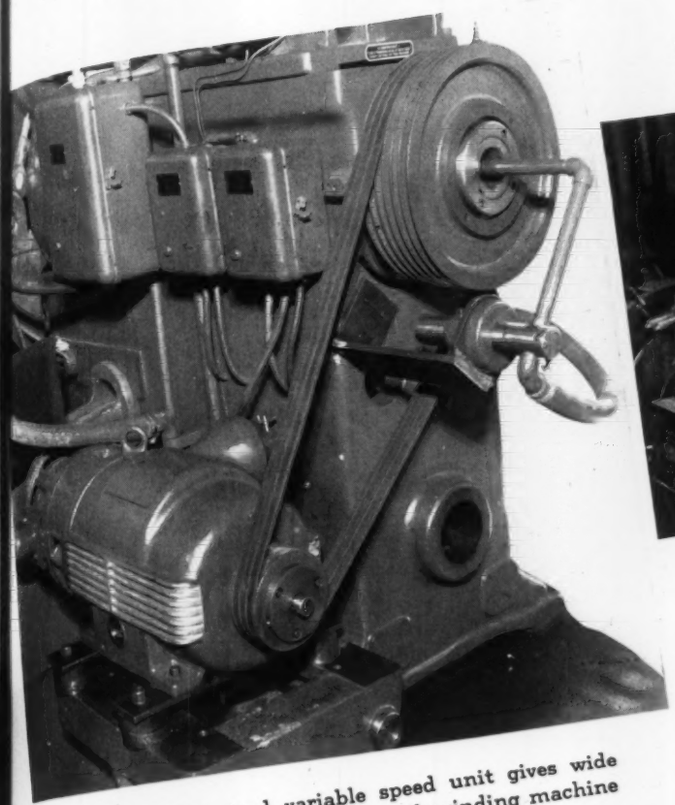
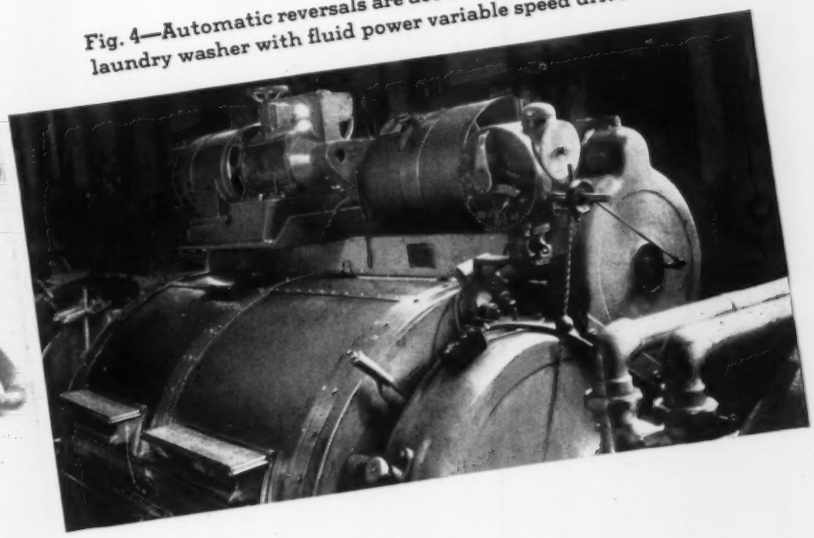


Fig. 3—Motorized variable speed unit gives wide range of speeds on this internal grinding machine

Fig. 4—Automatic reversals are accomplished on this laundry washer with fluid power variable speed drive



lar for applications in cramped quarters. Aboard ships, for instance, the motor component may be placed on the machine it drives; the electric motor and pump are placed some distance away where space is less limited. This same method of installation is used where danger from fire or explosion from the electric drive motor is prevalent. The drive motor and pump are housed in a fireproof chamber and pipes carry the fluid energy to the hydraulic motor.

Ranges in speed control vary with different types of variable speed units. Hydraulic units lend themselves to a wide range of speed control and may be reversed, but sacrifice some of the operating efficiency of a unit with a smaller speed control range. Mechanical units which may be reversed and have a wide speed range are being manufactured. In many machine applications the desired speed range is within certain set limits which allow the pulley and belt type of mechanical variable speed transmission to meet the conditions. Simplicity, economy and a minimum of wearing parts are found where the speed range is limited.

Machine tool makers have found the variable speed transmission a boon in many instances, providing the exact spindle or cutting speed necessary for the work being machined. Lathes in particular are adopting variable speed units with unquestioned success. Drastic reductions in machining time, better finishes and corresponding lower cost are the results of their use on these machines. A motorized type of mechanical unit has been installed on the internal grinder shown in *Fig.* 3. The exact grinding wheel speed is easily obtainable, either in using new wheels or compensating for wheel wear.

Application of a hydraulic transmission to a roll-fed printing press is seen in *Fig.* 1. The transmission units are mounted between the main drive of the printing press and a constant-speed driving motor. Use of the variable speed drive permits an unlimited number of speeds instead of the set number available with a multispeed motor. Smooth, uniform acceleration of the press is possible, protection against overload is afforded and an adjustable breaking force is available. On some types of presses variable speed units are used to provide automatic constant tension on the unwinder or rewinder drives. Paper breakage is practically eliminated in this way.

Automatic synchronization of a machine speed with the peripheral speed of cloth, paper or other material being coiled or wound is possible with the variable speed drive in combination with a dancer roll or similar device. Difficulty has been experienced by machine designers for years with textile, strip coilers and a multitude of other machines in which material is wound on rolls. Slip drives of a wide variety have been used to synchronize the machine speed with that of the peripheral speed of the coil but without complete success. *Fig.* 2 is an example of a variable

speed unit applied to a two-roll quetch and controlled by a dancer roll which synchronizes it to a main drive delivering power to a dryer. Cloth tension is accurately controlled by this method.

Varying a machine speed to synchronize its output with another machine or worker requires precise speed control. By means of a variable speed drive it is possible to change the speed of operation of the sandwiching machine, *Fig.* 5, in minute amounts to meet the requirements of the individual baker.

A compact fluid power transmission is shown in *Fig.* 4 installed on a large laundry washing machine. It provides individual drive and automatic reversals without panel board control or reversing of motor. The speed of the washing machine can be varied, of course, within the limits of the unit.

Flexibility and smoothness of operation are demanded of the hydraulic unit installed on the sheet metal feeding and straightening machine, *Fig.* 6. The transmission is driven by a 1200 RPM. motor and is coupled with an angle type standardized worm and gear speed reducer which drives the punch rolls. Heavy steel stock may be fed in any predetermined amount ranging getween 10 and 100 inches per cycle. The rate of feed is also adjustable up to a maximum of 200 feet per minute. Accuracy of stopping is held within limits of approximately plus or minus one-sixteenth of an inch. Acceleration and deceleration

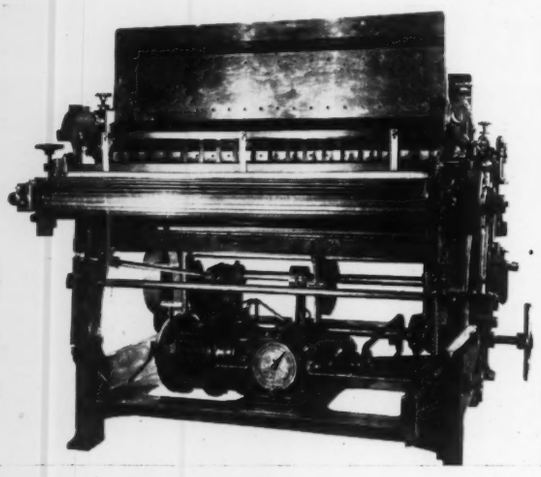


Fig. 5—Minute variations in sandwich machine output possible with application of speed change unit

is cushioned hydraulically with special provision made for decelerating to an accurate stop. The unit has operated remarkably well under severe conditions, being repeatedly started, accelerated to a high speed, and stopped at a frequency of as many as 15 complete cycles a minute.

Application of mechanical variable speed transmissions to sewage treatment plants has practically meant a new era in this field. Variation in volume and rate of flow, moisture content, percentage of solids, amount of bacteria are factors which must be met with variable speed equipment. Speed control enables an operator to proportion flow between pumps, screens, filters, mixing tanks and other units.

Machines which have been equipped with variable speed drives, both hydraulic and mechanical, within the last year include spring coilers, marble grinders, shoe lace tipping machines, tin plating equipment, wrapping

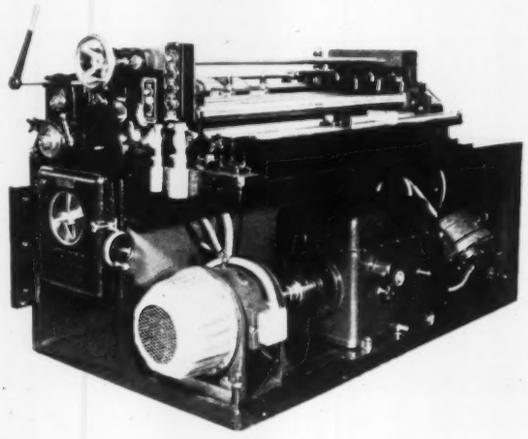


Fig. 6—Many sizes of stock are handled in feeding and straightening unit by varying the speed

machines, rubber panning machines, and many of the different types of machine tools, textile and paper manufacturing machines. This group is far from exhaustive but gives an idea of the wide variety of machines on which variable speed drives have been installed with complete operating success.

Remote control of variable speed transmission has been accomplished in several ways. Ordinarily a straight extension of the handwheel operating the mechanism or the pump stroke in a hydraulic unit is used for short distances. Chain linkages have been found suitable for many situations, but a small auxiliary motor mounted on the unit and controlled from some central point is used most extensively for distant control. Fitted with a worm reduction usually, the small motor can be controlled to operate the speed change device precisely. Hydraulically operated bellows or cylinders are coming into use for controlling the change speed mechanism. Few moving parts are necessary and one small connecting pipe serves to transmit the energy from the hand-operated bellows or cylinder to the variable speed unit. Peculiarities of application usually are the deciding factor in the selection of remote control equipment.

Speed control is admittedly desirable with practically any machine. On many it is mandatory. In some cases control offered in steps is sufficient but where exact control is needed or where synchonization with an operator or other machines is desirable then variable speed drives should be considered.

Acknowledgment is made to the following for their considerate assistance in the preparation of this article: American Engineering Co., Graham Transmissions, Lewellen Mfg. Co., Link-Belt Co., New Departure Mfg. Co., Oilgear Co., Reeves Pulley Co., and Vickers Inc.

We Drive by---

CHOICE of the type of drive for industrial machinery depends upon many factors, including the nature of the machine, conditions under which it will operate, policy of the machinery builder and preference of the customer. Obviously, what might constitute good practice in a clean type of factory might not serve at all under the rigors of a mine or in a cement plant. Some machines which normally would be motor driven would under certain conditions be driven by turbines. Such is true in paper mills where process steam is necessary and where tapping it for power adds very little to cost.

MACHINE DESIGN has made inquiry of chief engineers and other design executives of a number of well known companies building machinery of various kinds. The following statements, contributed especially for this issue, present significant indications of some general trends in machine drive development, and also afford clear understanding of certain definite factors which determine the nature of drive specifications.

"..... trend toward motor on spindle."

C. R. ROSEBOROUGH, President
Moline Tool Co.

BACK in the old days, I will say before the war, flat leather belting was used very largely on our machines, driving the machines from a countershaft which in turn was driven from a lineshaft. Then we came into motor drive, mounting a motor at some convenient location, generally on the column of the machine and connecting it by means of a flat belt. Where there was a vertical feed or vertical travel of the rail we would install an idler pulley which would keep the belt at a given tension as the driven pulley moved up and down with the rail.

Then we came into the V-belt drive using the same belt tightener scheme. Of late years we have mounted the motors directly on the rail and by means of the V-belt have eliminated the idler, there having been some objections to this idler. On our particular type of equipment we did not think it practical to connect the driving motor to the driven mechanism by means of gear and pinion such as has been done largely in presses and machines of that type.

There is a tendency lately toward the practice of attaching the motor directly to the spindle, particularly where no variation in speed is required. Even on variable speed machines a variable speed motor might be installed, although we have had no calls for such an arrangement as yet.

In addition we have supplied a quick change speed box, where gearing is acceptable, so that the operator of a machine can get quite a range of different speeds simply by shifting a lever something on the order of the shifting lever of an automobile transmission.

"..... V-belt is widely acceptable."

I. J. SNADER, Research Engineer
Ex-Cell-O Aircraft & Tool Corp.

ONE of the oldest and still today one of the most acceptable drives for machine tools, especially where smooth operation and high speeds are involved, is the belt drive. The V-belt, driving from an electric motor as the source of power, has become universally acceptable for general machine tool applications.

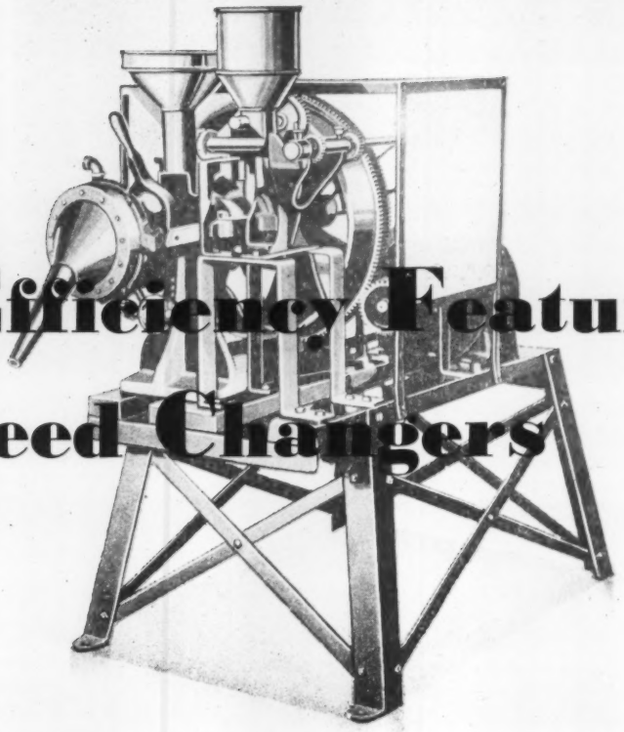
In cases where the ratio between the motor and the driven shaft is 1:1, it is sometimes advantageous to use a direct connected flexible coupling. This drive is frequently used in connecting the electrical motor to the hydraulic pump which serves to furnish the necessary fluid pressure for operating feed and rapid traverse actuating mechanisms and associated auxiliary devices.

Where an exceedingly smooth vibrationless drive is required and the speed is such that it can be obtained by direct connection to an electric motor rotor, the most satisfactory drive is obtained by mounting the rotor of the motor directly upon the driven shaft. This drive is extensively used in precision boring machine spindles and spindles for surface grinders where it has proved to be entirely satisfactory.

In many machine tools it is necessary to provide a

(*Continued on Page* 86)

Compactness, Efficiency Feature Modern Speed Changers



EVEN business depressions have their favorable aspects. Inferior products are forced off the market, the slowing down of business gives time for cogitation and retrenchment while new ideas and designs are introduced to meet increased competition. One such child of the recent lean years which has been a responsible factor in the improved appearance and operation of modern machines is the gearmotor. Closely related of course are the numerous types of special motors and speed changing units developed to meet unusual conditions and fill the demand for close-coupled drives.

Although gearmotors are not new, their application in machines was definitely limited until 1931 and 32. Older types had been manufactured in a few standard forms, but machinery builders as a whole had failed to incorporate them in their machines. Then came the vogue in all types of machinery and products, from automobiles to business machines, for symmetry and sweeping lines which can be accomplished only with a minimum of projecting parts or accessories. One has only to notice the general contour of the majority of machines being made today to realize the effect of this new styling upon their design. Bulky drives have been replaced by geared or special type motors and reduction units which lend themselves admirably to building-in purposes.

Electric motors are usually the most efficient type of prime mover for machines, but as they rotate at much higher speeds than the majority of driven equipment some sort of speed reduction is necessary. Such fundamental requirements as compactness, high efficiency, comparatively low cost, a minimum of wearing parts, and proper enclosure for safety have been ade-

Fig. 1—Peanut butter mill, above, is hardly recognizable as improved machine shown below,

Fig. 2, in which a built-in gearmotor is responsible for much of the change

quately answered in many cases by motorized reduction units.

Adding to the popularity of gear or special motors is the trend among machine designers to specify the size, shape and operating characteristics of the motors to be built into their machines. Building in of prime movers and reduction units where the gearmotor or speed reducer is an integral part of the machine, of necessity demands that fittings and shape of the unit conform to the general contour of the machine. As these motors are built to order in many cases the exact speed reduction may be specified and the finished unit will be adequate in every detail for the function it is to perform. Today we find many small machines in which the motor and geared head are practically the nucleus of the machine. The peanut butter mill, *Fig.* 2, utilizes a ball bearing gearmotor in such a manner. Improvements over the old style, *Fig.* 1, are evident from the comparison. Gears are hidden, there is no danger from exposed or moving parts, and appearance has been enhanced 100 per cent.

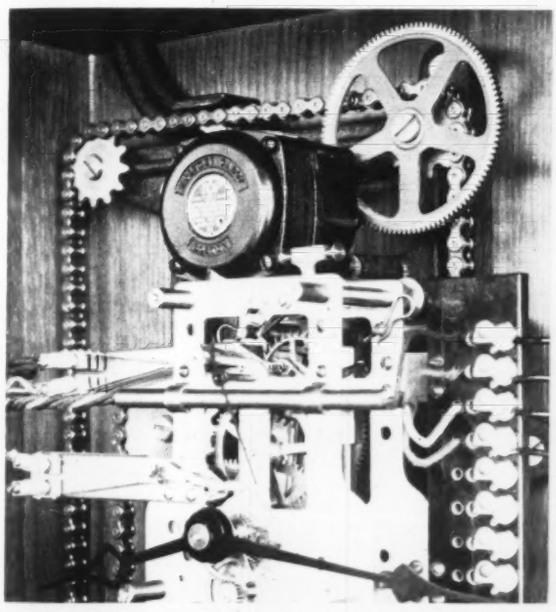
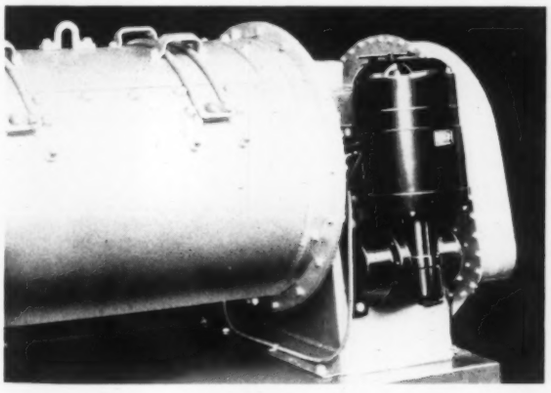


Fig. 3—Speed is reduced from 1800 to 15 RPM in the small gearmotor used in this clock to wind up the weight

Fig. 4—Built-in electrically operated brake is feature of this gearmotor which drives a tumbling barrel



To meet the conditions of different drives, several types of gearing are used in gearmotors. Parallel shafts usually employ spur, helical or herringbone gears arranged in planetary or non-planetary trains. Multiple reduction is common and speed is reduced as much as 100 to 1 and more in a compact gear head. Worm gears, straight or spiral bevels and hypoids give satisfactory right-angle drives.

Extreme speed reduction is accomplished in the small gearmotor, *Fig.* 3, used for the purpose of winding up a 30-pound weight on an electric clock system. Speed of the synchronous motor is reduced to 15 RPM for the output shaft. Some of the gears are fiber, making the operation quiet in spite of the high reduction. A mercury contactor operates to energize the motor after the weight has moved down about three inches. The gear reduction is so great that the weight will not turn the motor backward.

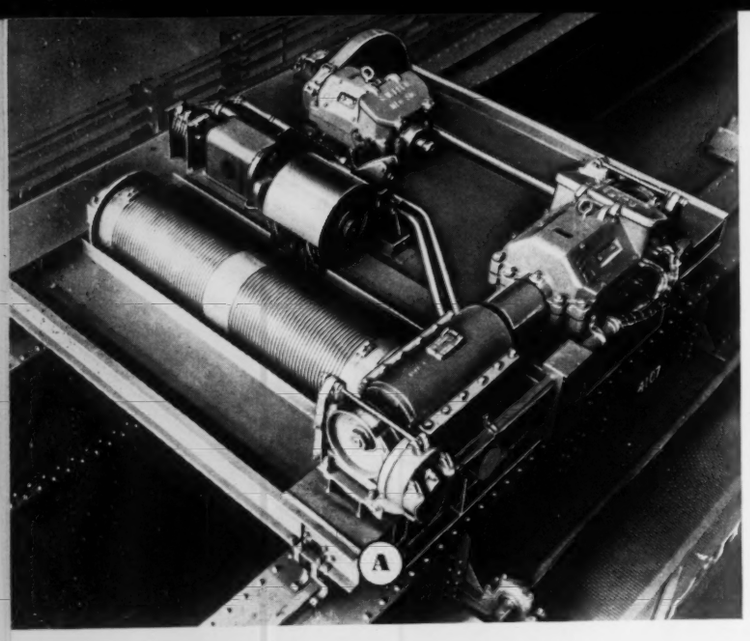
Brakes Sometimes Built in

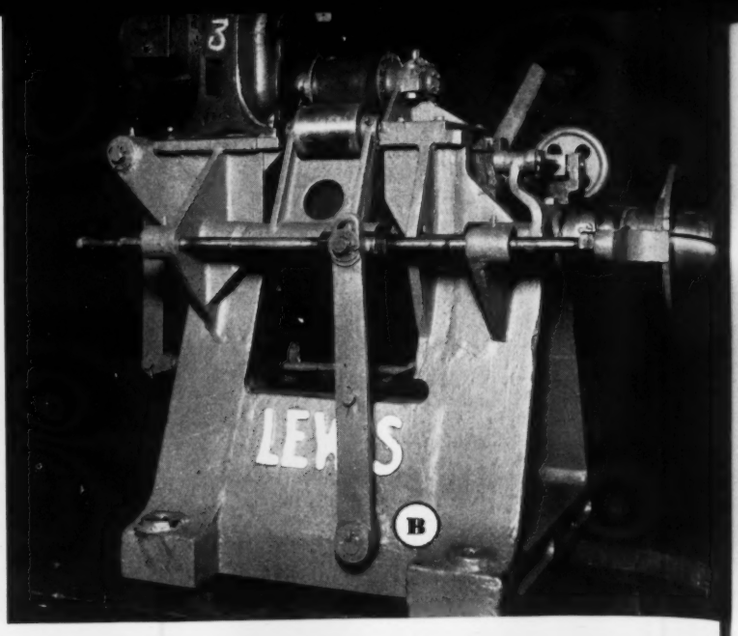
In some types of reduction units which incorporate a motor, the armature shaft has been extended and an automatic braking system built in. Machine designers have realized the benefit of utilizing both ends of the shaft, some specifying a straight drive at one end for a high speed pump and a geared head at the other; some using motors with two geared heads and different speed reductions.

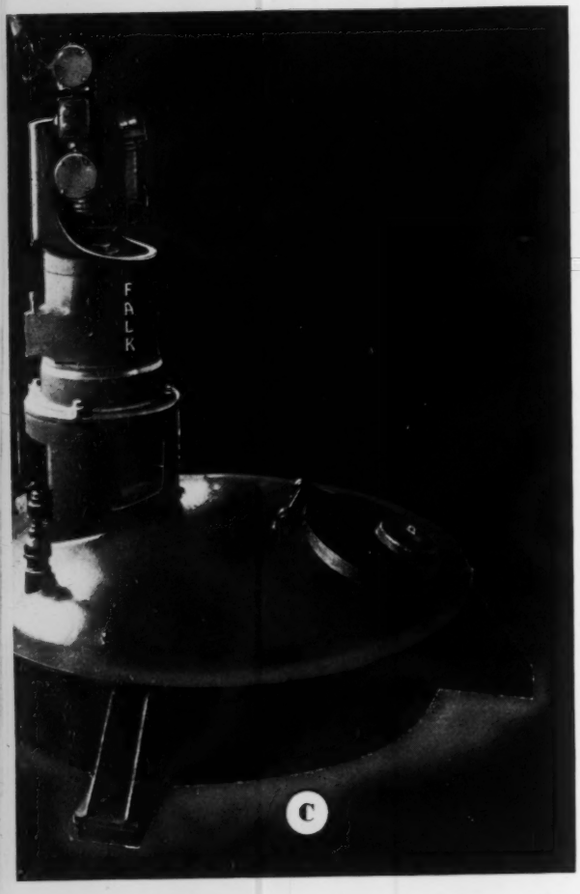
The motor driving the tumbling barrel, *Fig.* 4, is supplied with an integrally built, geared head motor on one end and an integrally built, multiple disk, electrically operated brake on the other. The geared head, of course, provides slow power where it is needed and the built-in brake makes possible the stopping of the barrel accurately for the correct position of charging and discharging.

Reduction units, motorized and plain, big and small, are following the general trend towards enclosed working parts. Gearcases are designed to lend themselves for building in or for neat attachment to a machine. Lubrication advantages are readily apparent in the enclosed unit which allows the gears to run constantly in a generous quantity of oil. Although many special machines employ exposed gearing for reduction, designers are attempting to shield, build in or adopt an enclosed unit wherever possible.

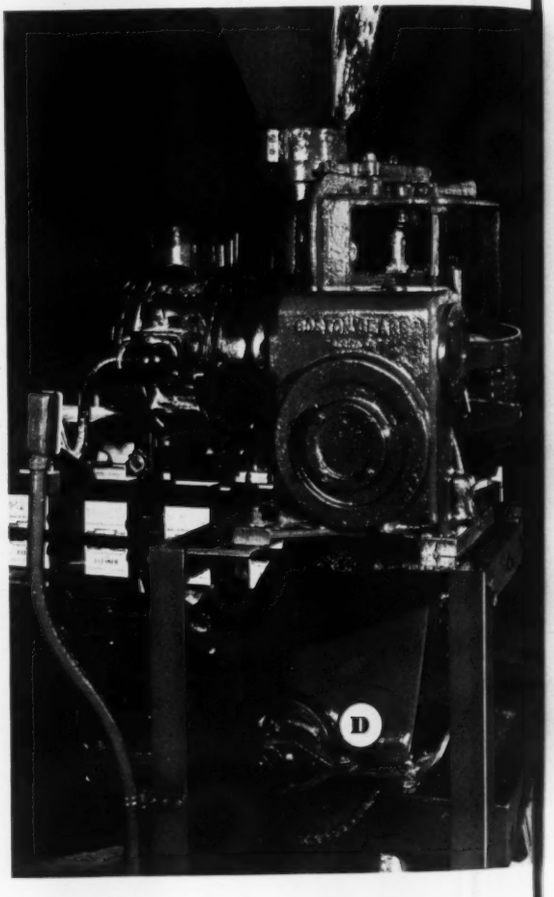
Power units are either directly connected as in the case of motorized speed reducers as seen in the machine application D on page 68, or closely coupled as illustrated in C, of the motorized paint mixer the same page. Efficient and compact speed reduction has been accomplished by the worm and wheel unit seen installed on the electric seam welder, E. Both ends

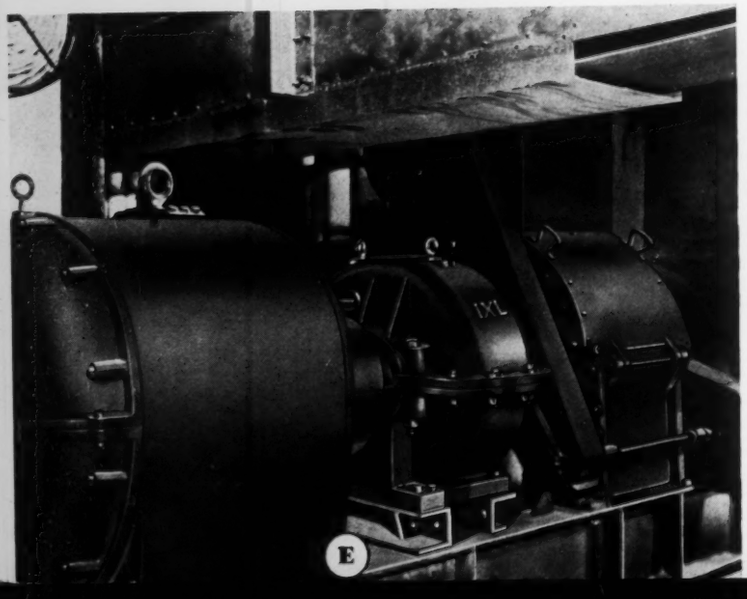


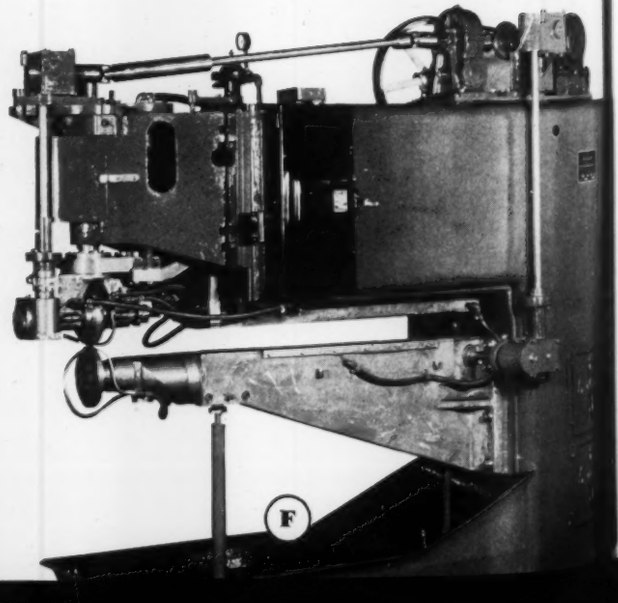




Speed Reducers Find Wide Variety of Applications as Built-in Parts of Machines







of the wheel shaft are utilized, one driving directly through universal joints to the head of the machine, the other fitted with a pinion for further reduction. The steel mill crane, A, exemplifies the complete building in of a reduction unit. Compactness, absence of exposed working or lubricated parts is obtained by this method of adapting the reduction unit to the machine. One end of the worm shaft is fitted with an electrically operated brake for holding the cable drum.

Application of a geared head motor to a heavy duty machine is shown in B, page 68, where a small five horsepower motor drives a strip coiler through gears and a flat belt. Reduction is from 1750 to 354 RPM.

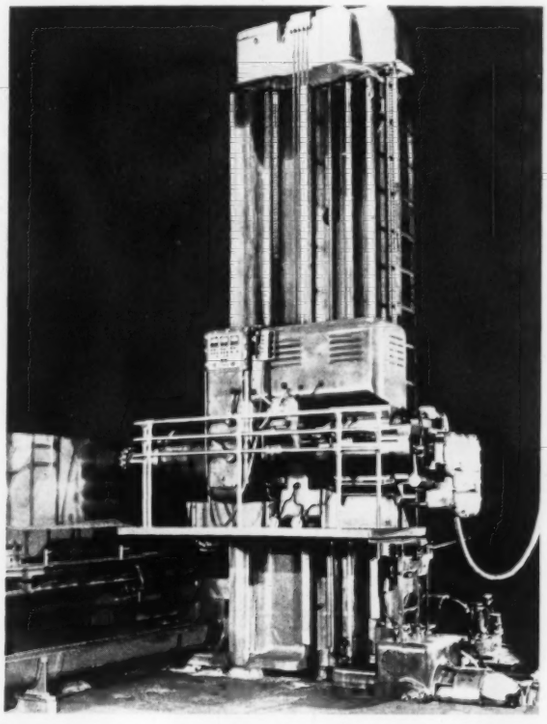


Fig. 5—Special and geared head motors on large milling machine make its operation precise and its control easy

Enclosure of a large unit is depicted in E where motor and reducer are coupled with little waste space.

In line with the mode for built-in applications, many types of special motors have been developed during the depression and post depression period. Dustproof, splashproof and explosion-proof motors have been designed to meet various severe conditions of machine operation. Many machines formerly driven from lineshafts now incorporate their own prime mover and precaution must be taken in those cases where damage from water, fire or explosion is possible to protect the motors and prevent danger to the operator.

The large milling machine shown in *Fig.* 5 is an outstanding example of custom-built machine tools that can be controlled as easily as small standard types. Complete electrification of the machine and the use of special and geared head motors have provided unusual flexibility.

An adoption of special motors for built-in purposes is shown in *Fig.* 6, a modern type double planer used

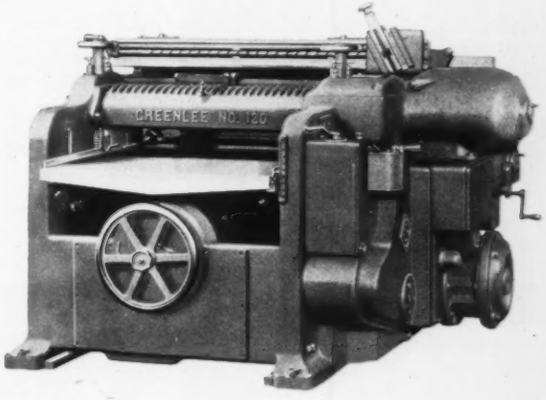


Fig. 6—Direct connected motor built into double planer gives smooth operation of the cutting cylinder

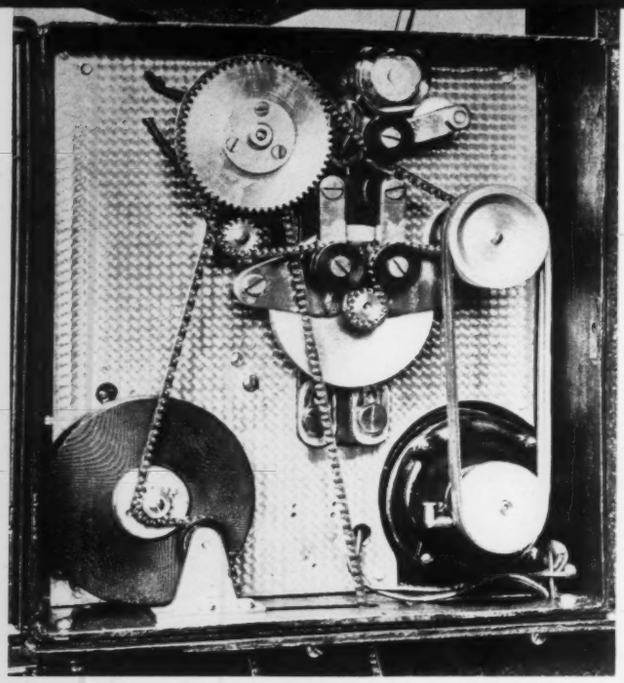
in the woodworking industry. Extremely smooth operation of the cutting cylinder is achieved by a direct connected high speed motor. The principle of the built-in motor drive is also applied to the separately driven feed mechanism, powered by a four-speed motor. The table on the planer is also actuated by a built-in high torque motor inside of the front lower girt, readily accessible for oiling or adjustments.

The ultimate field to be covered by gearmotors, motorized reducers and enclosed reducing units appears without limit. Gearmotors have filled a crying need for certain applications and their wide use in low horsepower capacities attests to their popularity. For higher horsepower applications standard enclosed type speed reducers perform efficiently and offer compactness and quietness. Special motors, of course, have been and will continue to be used in a wide variety of special applications. From the mechanical engineer's viewpoint, there are practically no limits in horsepower rating to the power that can be transmitted efficiently by reduction units.

Whether it is appropriate to give the depression credit for the strides made in the past few years in reduction units is open to question, yet more advances have been made in a comparatively short period than in twenty years prior to 1930. Undoubtedly the discarding of obsolete ideas during the depression period has influenced machine design tremendously and indirectly has had its effect on speed reducing devices.

Acknowledgment is made to the following for their considerate assistance in the preparation of this article: Allis-Chalmers Mfg. Co., Boston Gear Works, Inc., De-Laval Steam Turbine Co., Foote Bros. Gear and Machine Corp., General Electric Co., Holtzer-Cabot Electric Co., Master Electric Co., Peerless Electric Co., Philadelphia Gear Works, Reliance Electric and Mfg. Co., and Westinghouse Electric and Mfg. Co.

Chains — Their Application



By L. E. Jermy

THOUGH one of the oldest forms of drive from prime mover to machine, chain drives have earned —and continue to occupy—an enviable place in the considerations of the designer. If information on some of the outstanding work that chains have been called on to do day in and day out for periods of twenty years and more, could be collected and presented in a complete volume, the reason for their front-rank position would be readily apparent. But details on those old drives are not readily forthcoming. The machines on which they are installed are virtually obsolete and furthermore are uninteresting except from the standpoint of long-wearing parts that have held up for an almost inconceivable length of service.

One of the primary reasons these drives have performed so well is that they were designed, in most instances, by engineers having a thorough knowledge of chain driving practice. The services of manufacturers of chain drives were, and of course still are, at the disposal of the designer of machines. Their ready assistance facilitates the selection of the correct type and size of chain and sizes of sprockets for the particular conditions to be met. Methods and frequency of lubrication, as well as other factors governing the drive, also can be checked to insure the best possible results.

In more recent years it has become desirable for chain manufacturers—to meet the increasing tempo of business and the demand for quick deliveries—to establish various forms of "stock" drives which are immediately obtainable on order and which can be selected by the designer of machines from the catalogs or literature of the chain companies. Chain driving equipment for certain horsepowers, speeds and types

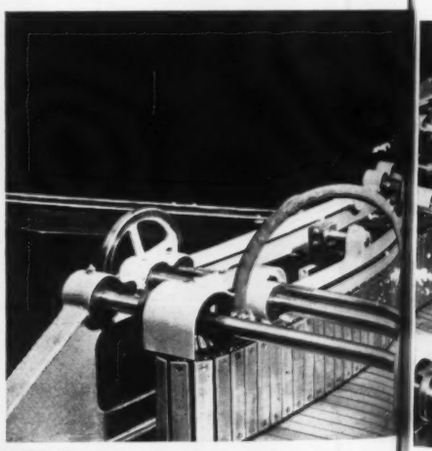
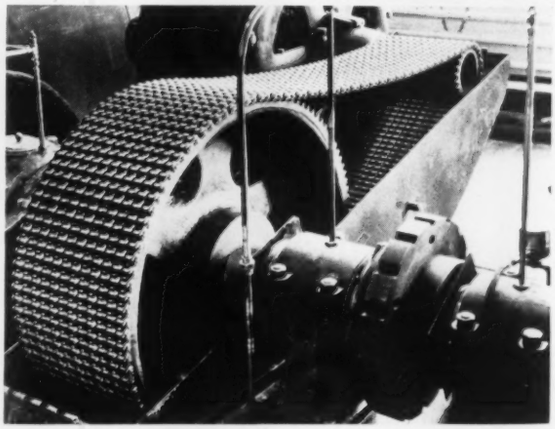


Fig. 1—Left—Light silent chain with a pitch of only three-sixteenths inch is used extensively in this movie projector

Fig. 2—Right—Packaging machines are particularly suited to chain application

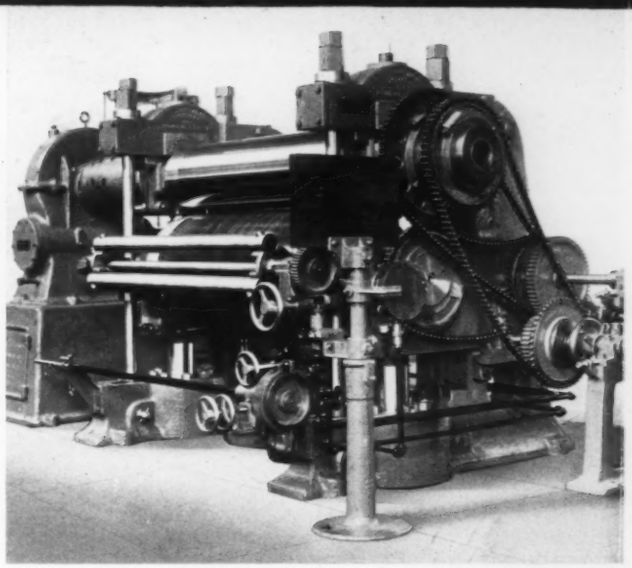
Fig. 3 — Below — Speed increasing drive utilizes twelve - strand roller chain. Lubrication is by continuous oil flow



in Machines

of drive is listed comprehensively, and information for the combatting of severe conditions is capably presented. It is thus comparatively simple for an engineer with only slight knowledge of chain driving to select an adequate drive; but if the drive is to be adopted as standard on a line of machines, or if unusual conditions of service are apt to arise, the wise policy is to consult the engineers of the chain manufacturer for their advice.

When the designer is making his own selection of type of driving chain, silent or roller, he is invariably faced with the question as to which is better. He may well be puzzled, because there are few applications of machine driving that cannot be adequately met by either type. In general, however, it may be said that for particularly quiet requirements the silent chain is more commonly used while for severe service or less clean conditions, the roller chain is recommended.



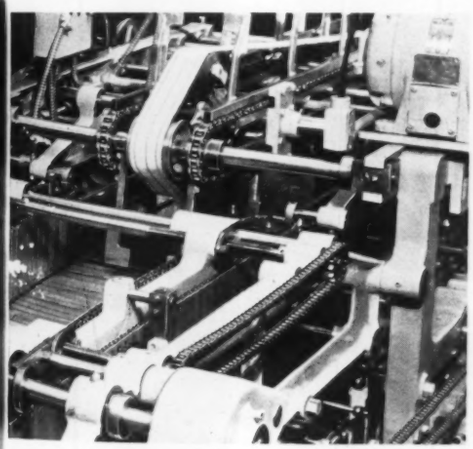


Fig. 4 — Right — Primary and secondary rolls of calendar are driven by roller chain (covers removed)

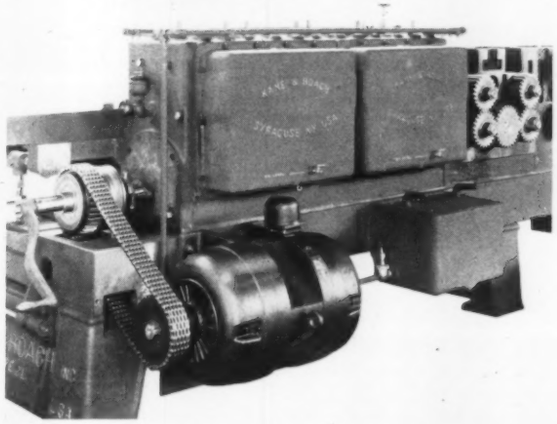
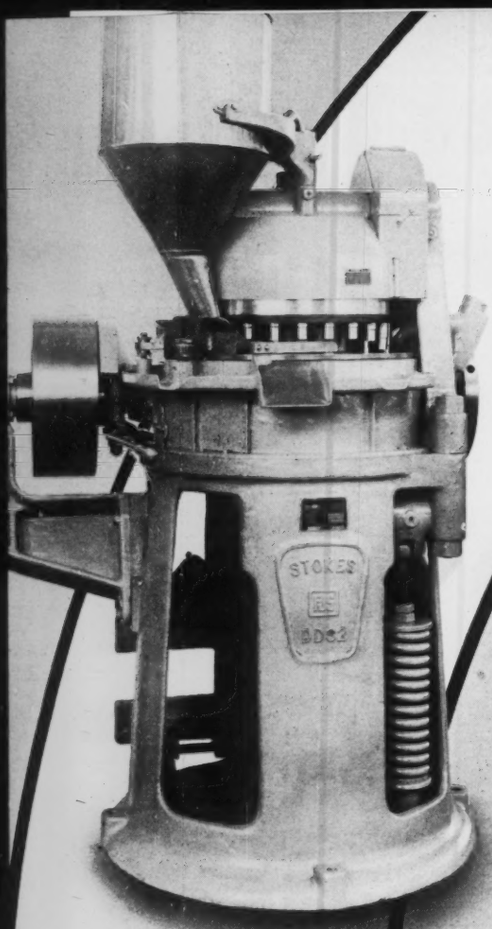


Fig. 5—Below—Built-in silent chain drive, with driven sprocket adapted to clutch control, is used effectively on cold roll forming machine

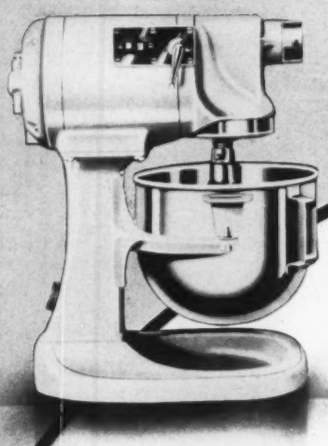
This does not mean that roller chain drives cannot be designed to operate as quietly as the silent type under certain conditions. Many instances are on record where such results have been achieved. Ordinarily, however, ample space is necessary for drives of this type in order that a sufficient number of teeth can be provided in the pinion of the drive without reaching an excessively large diameter. Pinions having 25 teeth and upwards generally can be relied upon to give smooth and quiet operation. A desirable minimum for any type of drive is 19 teeth and the desirable maximum 140.

There are, of course, many special drives having wheels with more than this desirable maximum number of teeth. In one case, to meet an extremely high reduction, a triple (three strands in combination side-by-side) roller chain was specially developed. The two outer strands of this are continuous, and the middle strand is provided with extra space between the rollers so that two rollers at every tenth pitch engage the sprocket. The sprocket tooth width is made wide enough for this center strand and teeth are cut only for engagement with the intermittent pairs of rollers. The customary roller clearance is greatly increased so

(*Continued on Page* 92)



Oversize disk clutch easily transmits the 10 horsepower required to drive this Stokes plastic rotary preform press, above. Modern mounting of the drive motor on an adjustable swinging bracket insures proper tension at all times in the V-belt drive



Gearmotor becomes integral part of the machine in this Hobart food mixer, above, producing a compact well-modeled unit. Power application is direct through spur gears; zinc die castings form base of the machine

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Design Fe
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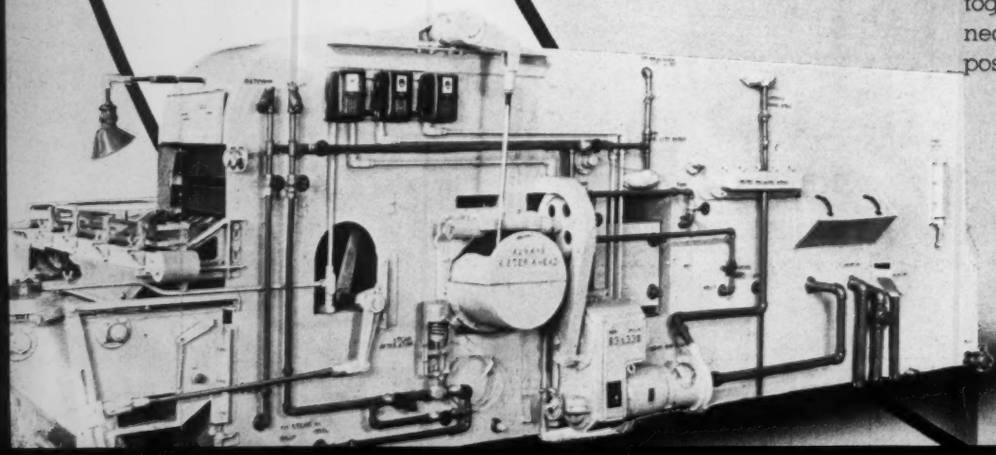
A Pictorial Presentation o
from the Standpoi

Unique method of mounting the bowl on ball bearing rolls and spinning it on its own circumference insures permanent alignment between bowl and dough race in the American dough rounder, left. Enclosure of all operating mechanism together with direct connected built-in motor makes possible its modern appearance

Motor driving change-speed unit on Cleveland Union bottle washer, below, also drives centrifugal pump which develops pressure for cleaning spray. Bottles move on roller chain conveycr and speed is regulated according to bottle size



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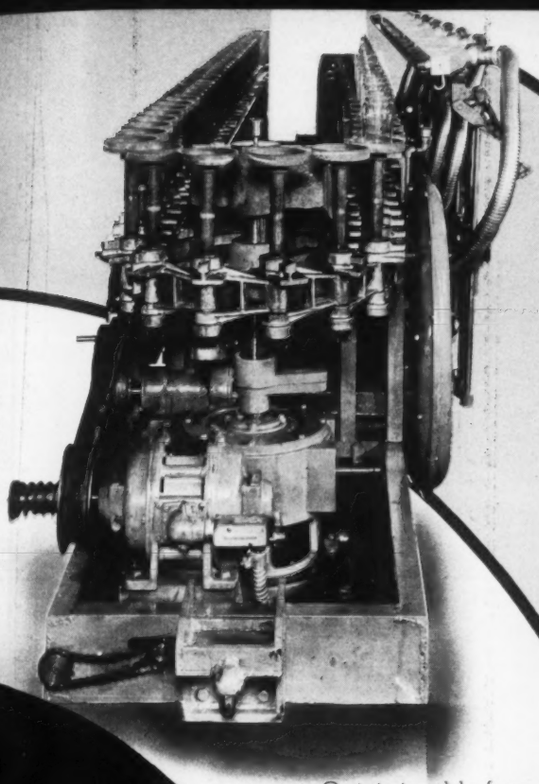

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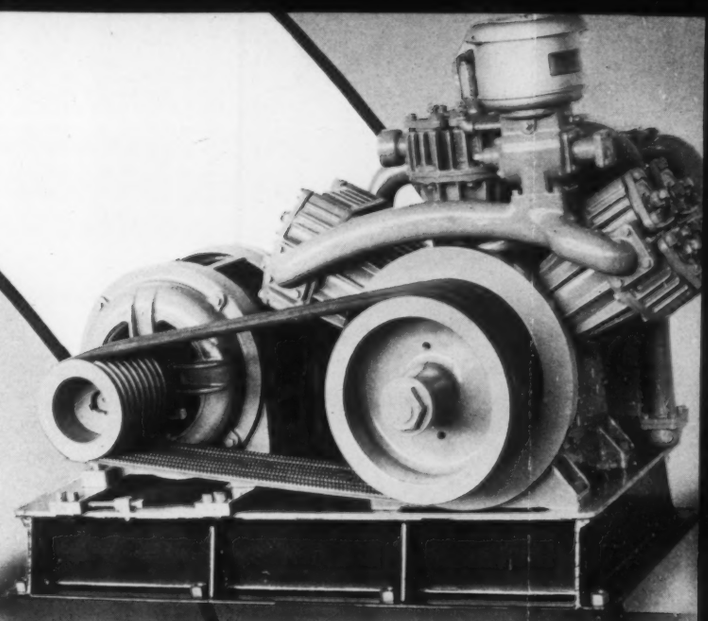

Eight V-belts drive this high capacity, two-stage, air-cooled Ingersoll-Rand compressor, above. Two-staging operation requires less power and keeps valves cooler. Lubrication is accomplished by the cranks dipping in oil kept at constant level regardless of level in crankcase

Quiet, trouble-free operation is accomplished in the Roa paint conditioner, below, by enclosing the entire moving mechanism in a sealed reservoir of oil. Eccentric shaft that actuates paint container is mounted on roller bearings

n Features
v Machines

entation of Recent Machinery
Standpoint of Design.

Variable speed control and speed reduction are accomplished by two separate units which are easily seen on the Federal welding machine, below. A worm and gear speed reducer stands up under the heavy loads and a single pulley variable speed drive permits sufficient speed regulation

drive is obtained on the
ironer, below, with a small
er chain. Motor is connected
sprocket through set of gears
may be shifted in and out of
o produce several speeds.
chine is finished with porce-
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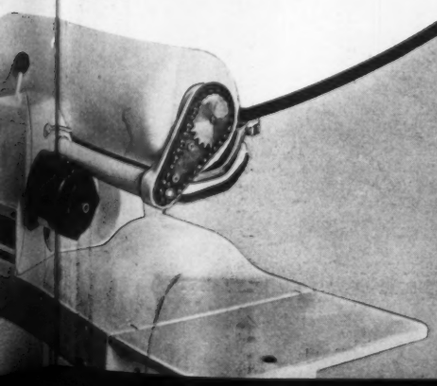
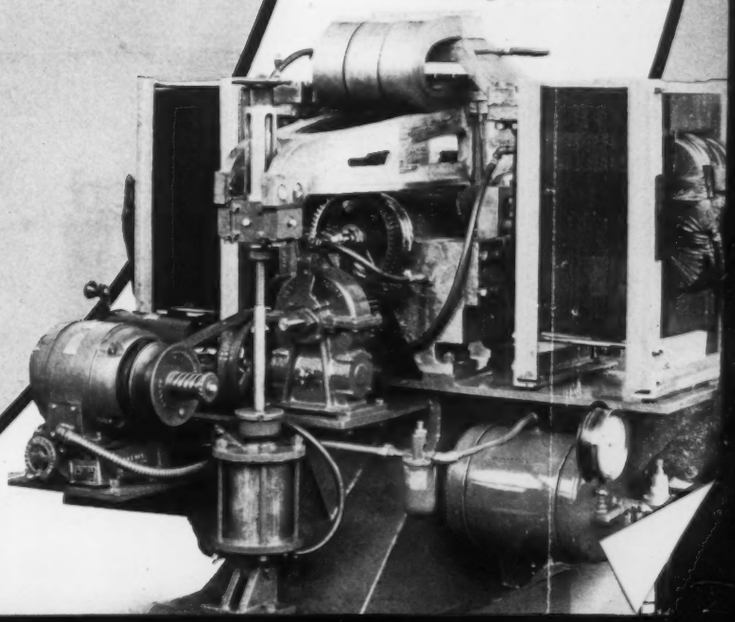
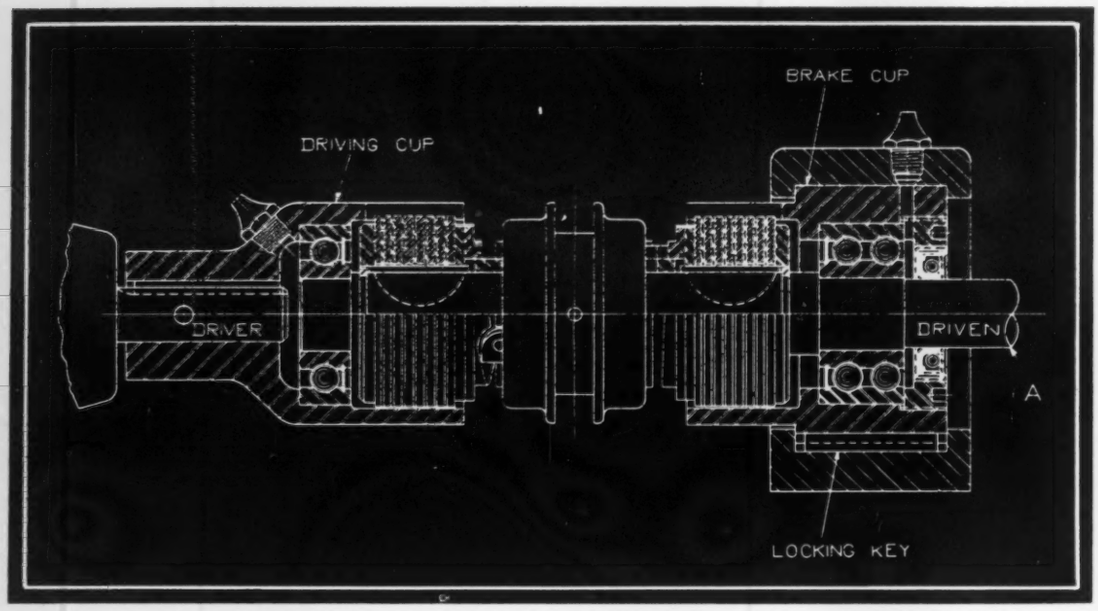






Upon disengagement of clutch at left, multiple disk unit at right instantly acts as a brake

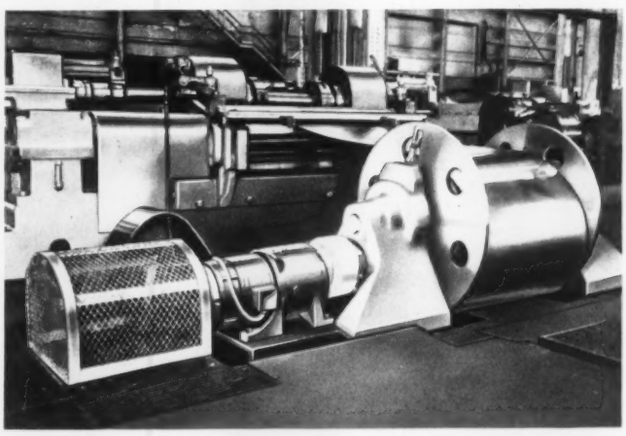
Clutches and Couplings Are Now Highly Specialized Units

By Guy Hubbard

CLUTCHES and couplings, which are rather closely related details, originally fell within the realm of the millwright rather than of the machine designer. It was only when major refinements began to be made in power-transmitting equipment, and more particularly when power drives began to be incorporated into machines, that the machine designer definitely came into this picture. Much ingenuity was shown by millwrights in the development of the early clutches and couplings and upon the foundations laid by these practical pioneers have been based the designs of many of the highly refined units of the present day.

While designers of machinery have developed and still are developing their own designs of clutches and couplings to meet specific requirements, specialization in this field has become so widespread that in most cases standard units are available which will meet conditions as well—if not better—than the average independently designed unit. Therefore, before attempting "private" designs, the creator of a new machine will do well to study his clutch and coupling needs in terms of standard commercial units, if necessary calling in the engineers of clutch and coupling manufacturers to go over the preliminary layouts with him. Nine times out of ten it will be found that units can be purchased out of stock which—with slight modifications in some instances—will serve the purpose as well or better, and more economically, then those designed and manufactured by the machine builder.

This trend toward adoption of standard clutches and



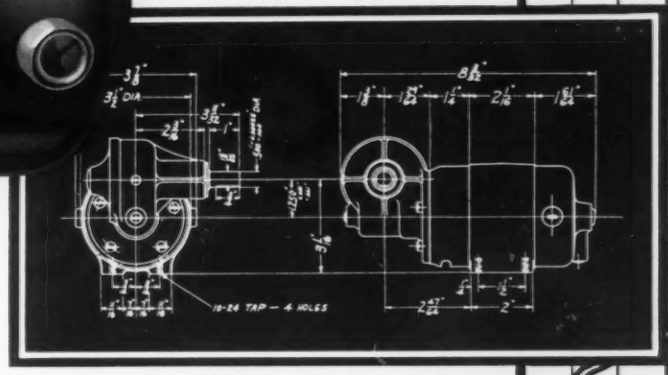
This mechanism for reeling up strip steel is driven from a motor-reducer through a chain-type clutch

BUILD EXTRA

Power Hours

INTO YOUR PRODUCTS

TYPE
KL MOTOR



Extra "power hours" built into Dumore motors through precision manufacture have resulted in their selection to drive delicate telescope controls, retractable landing gear of aircraft, life-saving medical equipment and hundreds of other machines, the salability and success of which are so contingent on the dependability of their motors.

If your product is to be driven by an A.C.-D.C. motor of 1/600th to ¾ h.p., for 0 to 60 cycle current, here's why you can depend on Dumore motors: Armatures are dynamically balanced . . . commutator leads swaged by special process . . . commutators ground concentric with bearings . . . armature windings sealed against "breathing" . . . every unit run-in to seat brushes and 5 times inspected. Below are listed the specifications of a typical Dumore motor with gear unit. Write for catalog of other sizes and types. An application blank for FREE Engineering Service will be included.

SPECIFICATIONS—TYPE KL MOTOR

Class of Motor	Plain Series Univ. (0-60 Cycles)
Construction Details—	
Degree of Enclosure	Open
Method of Cooling	Internal Fan
Bearings	Composition Bronze
Lubrication—Gear Unit End	Grease Packed
Commutator End	Oil well and wick
Direction of Rotation—looking at gear shaft	Counter-clockwise
Housing Material—Motor	Cast Iron
Gear Unit	Die Cast Aluminum
Weight	7 lbs. 8 oz.

Full-load Rating—Continuous Duty—40° C. Rise.

Voltage	115 Volts 60 Cycles A.C.			115 Volts D.C.		
Ratio	5-1	14½-1	34-1	5-1	14½-1	34-1
Amperes	1.60	1.52	1.38	1.58	1.48	1.38
Watts	160	146	138	182	170	159
Horsepower	1/15	1/18	1/27	1/9	1/12	1/20
Torque (lb.-ft.)	.30	.60	1.00	.50	1.00	1.29
Full Load R.P.M.	1200	450	200	1200	450	200
No Load R.P.M.	2000	770	325	1900	760	315
Efficiency	32%	30%	19%	48%	35%	23%

Performance curves sent on request

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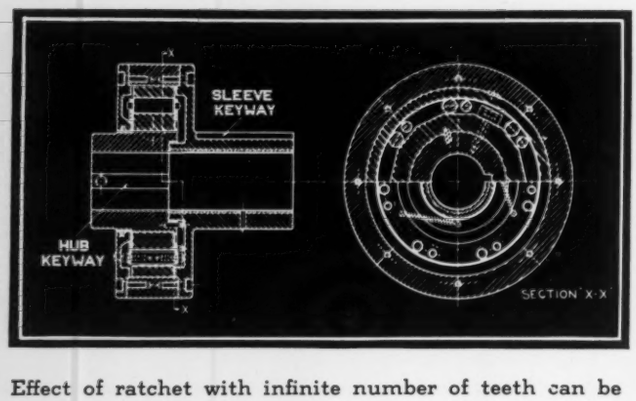


Effect of ratchet with infinite number of teeth can be attained with this type of over-running clutch

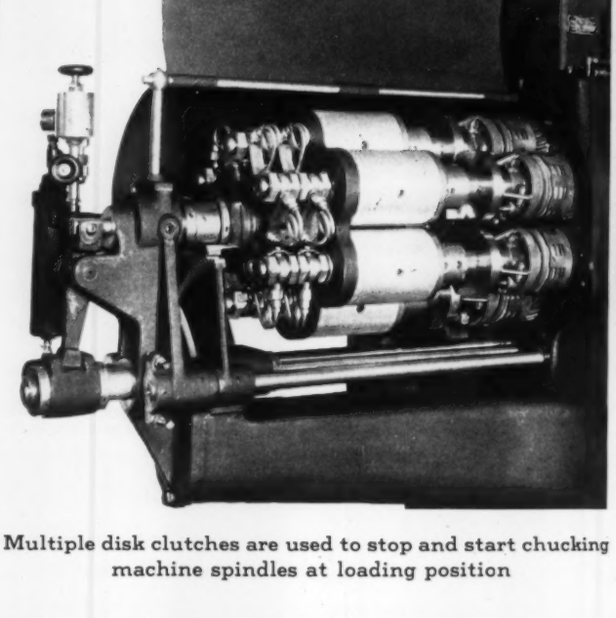
couplings became obvious in the automotive industry before it did in industrial machinery, but in the latter field it now has become unmistakable. Incidentally, many recent refinements in industrial clutches and couplings have developed from automotive practice. That is true particularly of those where maximum carrying capacity and quick, dependable action must be embodied in units of small size.

As indicated at the beginning, the line of demarkation between clutches and couplings is not very definite. Originally a coupling was a simple sleeve connecting two shafts—compression, set screws, keys or combinations thereof being depended upon as the driving means. Deadly protruding screws were common in the older types of couplings and the designer by all means should see to it that they do not recur in new designs. Here incidentally is an ideal place to use hollow head screws.

Next to the sleeve coupling from the standpoint of simplicity comes the flanged coupling. In the rigid form, this consists merely of a pair of hubbed flanges, each one keyed or locked by set screws to the end of its shaft, the two being bolted together face-to-face thereby effecting the connection. It is from this type that many of the more complicated forms of couplings, as well as many of the clutches, have sprung. For rigid connections it still is thoroughly acceptable, provided that the hazards of exposed bolt heads and nuts are eliminated.

Beyond this point the coupling becomes more than a mere connector. It becomes a safety device, a medium for counteracting the effects of misalignment, a cushioning medium against pulsating torque and on occasion a clutch which will slip in the event of shock loads, overloads and accidental locking of the mechanism. A common form of safety coupling for overload protection is that employing "shear pins" of wood, copper or mild steel for the driving connection between the two flanges.

A thing to be guarded against in connection with their use is the inclination of stupid operators to replace a sheared safety pin by one of tougher material —drill rod for instance—thereby bringing about a general smashup of the jammed mechanism. The same hazard exists with friction couplings set to slip at predetermined loads—unless the setting be locked against unauthorized tampering.



Multiple disk clutches are used to stop and start chucking machine spindles at loading position

Still in the category of the safety couplings, although of highly advanced design, are those of magnetic type where one side is a field and the other an armature. Also those of hydraulic type where one side is the casing and the other the impeller, commonly called the "fluid flywheel." Both of these varieties are clutches and torque convertors as well as couplings. Incidentally the first is not to be confused with the electro-magnetically-operated friction clutch.

Of the many kinds of self-aligning couplings the choice rests largely upon the degree of "float" required, how continuous the state of misalignment is and how much cushioning effect is desired. If the misalignment

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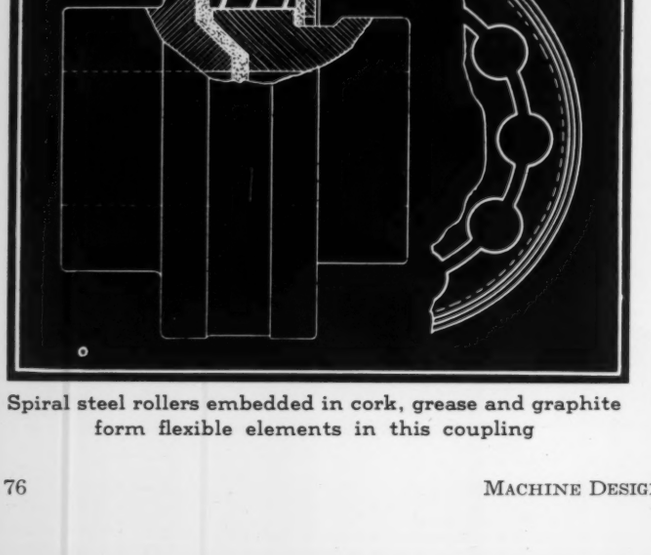

Spiral steel rollers embedded in cork, grease and graphite form flexible elements in this coupling

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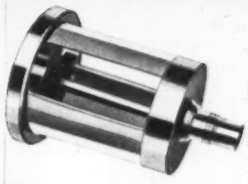

2 THREE TAPERED ROLLERS carrying Fellows beveled pinions which mesh with

3 A RING GEAR which is connected to the output shaft. The three rollers are encircled by

4 A CONTACT RING & RACK whose position is varied to change the speed by

5 A CONTROL WHEEL & PINION A single turn changes the speed from one-half motor speed thru zero to reverse.

LONG AWAITED, NOW HERE!

A mechanical variable speed transmission moderate in price, simple, completely self-contained and running in oil, using no belts, cams, fans, pumps or ratchets, and giving **unlimited** speed range—all the way to zero and reverse, if desired—at a single turn of a wheel. . . . And precision made by Fellows, world-famous for good machine tools!

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FIRST to give speeds from one-half motor speed, through zero, to reverse. **FIRST** to drive through quiet, positive internal gearing . . . **FIRST** to give finger-tip control with full speed range at a single turn . . . **FIRST** to suit the need—constant torque or constant horsepower by a simple change of gear ratio . . . **FIRST** straight-line unit to give positive protection against overload without damage to the transmission . . . **FIRST** unit built like a modern speed reducer, self-contained, splash-lubricated, without belts, cams or pumps . . . **FIRST** to combine the functions of infinite speed variator, speed reducer, automatic centrifugal clutch and load-limiting device.

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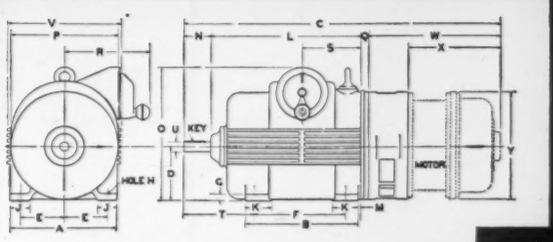
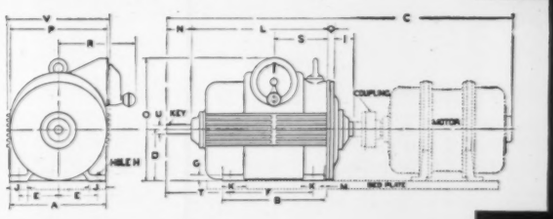
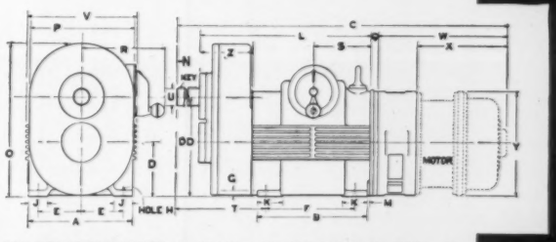


BUILT-IN MOTOR TYPE—Uses any make or speed of motor, flange mounted by Graham on unit through adapter. Two speed ranges:—E (extreme) with output speed from 40% motor speed through zero to reverse, or N (normal), from one half motor speed to one-eighth motor speed. Control, at right or left hand, changeable by purchaser.



COUPLED MOTOR TYPE—Uses standard motor joined to unit by Graham or purchaser, through coupling on common base. Built-in motor type is convertible by purchaser to coupled type without disturbing transmission, an exclusive Graham feature that reduces inventories while providing for motor maintenance in emergency.



GEARED-HEAD TYPE—Available with either built-in motor, as shown, or with coupled motor. Incorporates reduction up to 7:1 or step up to 4:1 giving full motor power at top speeds as high as 3600 R.P.M. or as low as 60 R.P.M. Exclusive Graham design makes this unit scarcely any longer than standard type. Ideal for low speed drives since further reduction may usually be had if needed by chain or open gear—a pronounced economy!

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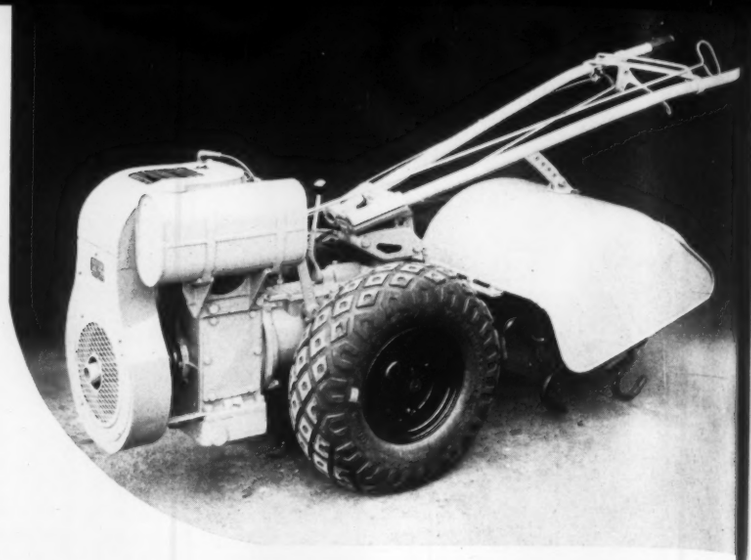

Fig. 1—Small gasoline engines serve effectively on mobile machines, also on stationary equipment remote from power lines

Don't Overlook Unconventional Driving Methods!

DIRECT connected water power probably was the earliest form of mechanical drive to be applied industrially. Scattered along streams in the older parts of the country are to be seen stone walls. Many of these once supported a simple type of mill wherein an up-and-down saw was driven by a crank on the waterwheel below. Until the era of central station power arrived, mills and factories continued to cling to the banks of streams, their machinery still being connected to the waterwheel—although of course through much more elaborate systems of mechanical transmission.

With widespread distribution of electricity there came about "decentralization" of power drives; first to smaller groups of machines, to individual machines and to various units within the individual machine. It is interesting to note, however, that with the development of various prime movers in compact form requiring little expert operating attention ("power plants in retail packages", so to speak) there has of late years been a tendency to turn again toward direct connection of the prime mover to the machine. An outstanding example of this has been in the field of transportation. Through the development of the gasoline engine, "individualized transportation" in the form of the automobile arose to challenge mass transportation by heavy steam train.

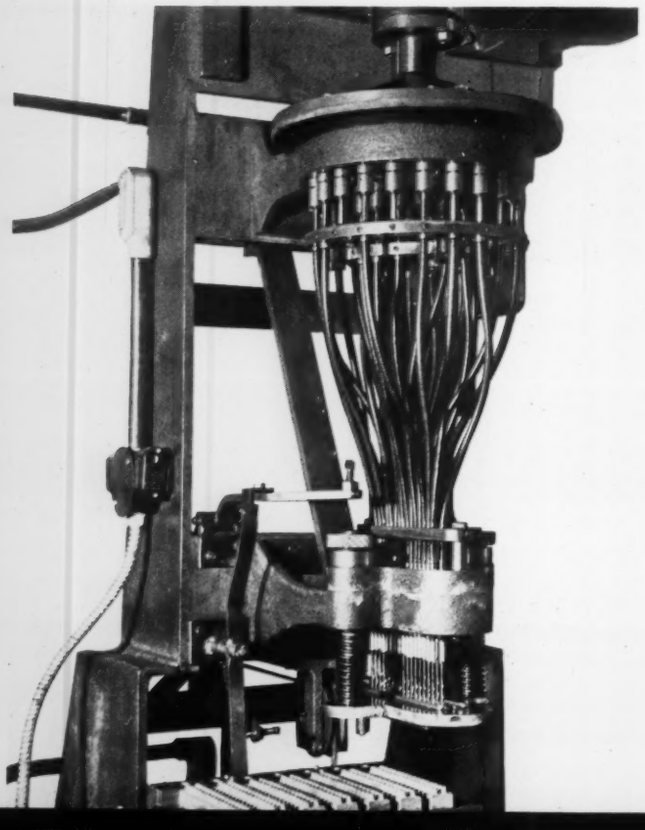

Fig. 2—Flexible shafting often will solve design problems involved in driving of units which do not remain fixed in relation to main power source

While this article by no means deals exclusively with this subject of decentralization of machine driving power, this trend is apparent in some of the cases presented, that depicted by *Fig.* 1 in particular. The use of a small air-cooled gasoline engine on this garden tiller is but one of the many applications of small internal combustion engines of this kind. They are widely used to replace man and animal power, especially on farms away from power lines. Applications include washing machines, cream separators, woodworking machines, small lathes, etc., as well as various self-propelled implements.

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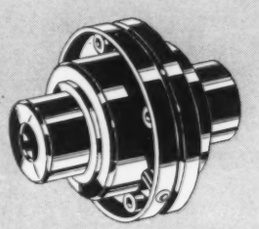

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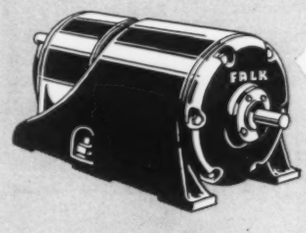

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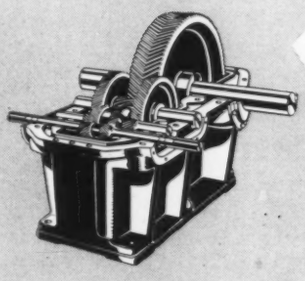

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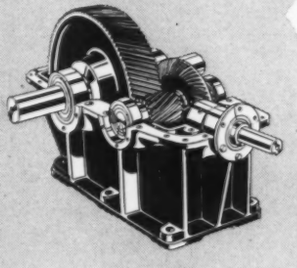

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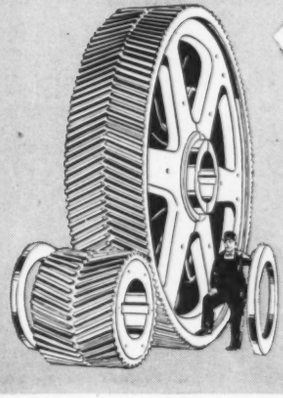

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HEAVY DRIVES, MARINE DRIVES, OIL PRODUCTION UNITS, WELDING, CONTRACT MACHINING, STEEL CASTINGS.

many ways, of which the electrical method has been the most common of the newer systems. Engineers should not lose sight, however, of the possibilities of various mechanical methods which often afford simplicity, economy and flexibility. The flexible shaft is a case in point. Long used as a means for driving hair and wool clippers, speedometers, dental engines and other small mechanisms, it too frequently has been thought of only in connection with such light services. Actually, modern types of flexible shafting are efficient, durable and capable of transmitting a considerable amount of power, with the advantage that they will carry the power "around corners" and to units which do not remain in fixed position in relation to the main power source.

An example of ingenious and practical application of flexible shafting not to one but to a large number of driven units is presented in *Fig.* 2. This 32-spindle machine is designed for drilling cast iron gas burners. The multiple flexible shafts not only allow for easy adjustment of spacing of the drilled holes, but also allow for up and down movement of the drilling head without use of slip joints and other complications. Use of this shafting also is successfully made in drives on printing and textile machinery and engraving machines.

Where unusually high speeds are required, the direct-connected turbine — either air or steam driven — sometimes affords a practical solution to the drive problem. While compressed air is a rather expensive form of power and therefore not recommended for driving heavy machinery, an air turbine does serve as an ideal motor for driving a woodworking machine such as the high speed router shown in *Fig.* 3. The 3-stage air turbine, which gives spindle speeds up to 22,000 revolutions per minute, is built into the head of the machine. The turbine is controlled by a governor which automatically adjusts the flow of air to suit the load. On smaller machines similar turbines are operated successfully at speeds as high as 60,000 revolutions per minute. A designer may sometimes have to weigh the possibilities of this pneumatic turbine drive against those of high frequency electric motor drive which is now being used for similar purposes.

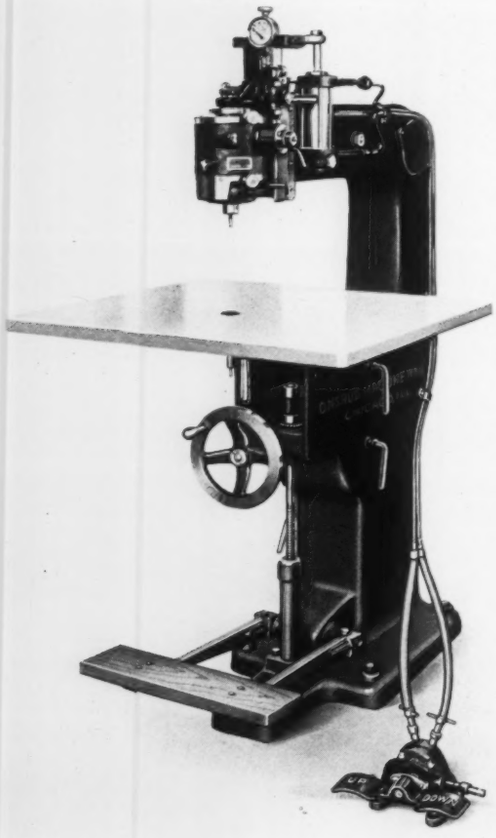

Fig. 3—If unusually high speed is required on light duty, the air turbine offers possibilities

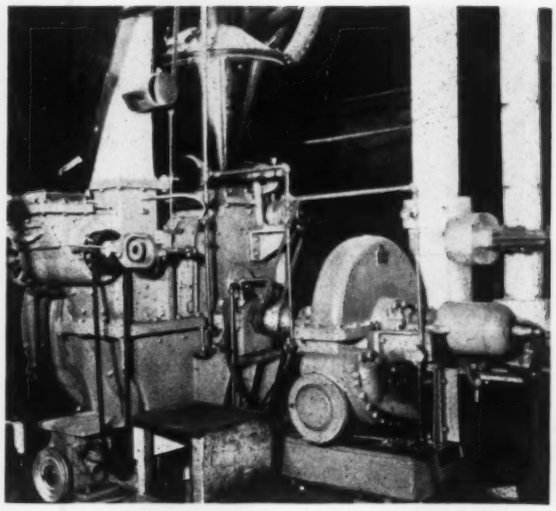

Fig. 4—Direct drive by steam turbine is practical where steam is readily available

Applications for Steam Turbines

Direct-connected steam turbines are, of course, suited to driving heavy machinery, but ordinarily only in locations where steam is readily available. Where steam is used in a process, manufacture of paper for example, it sometimes can be used for driving the machine without lessening its value as far as the process use is concerned. The turbine will merely act as a convenient form of reducing valve. This factor — as well as speed requirements — accounts for individual turbine-drives on machines such as those used in the papermaking industry.

The turbine-driven coal pulverizer shown in *Fig.* 4 is another case where connection to a steam line is very convenient. Not only is steam close at hand, but also operators familiar with its handling are present at all times. Added to this is the fact that the speed of the pulverizer is such that no reduction is re-

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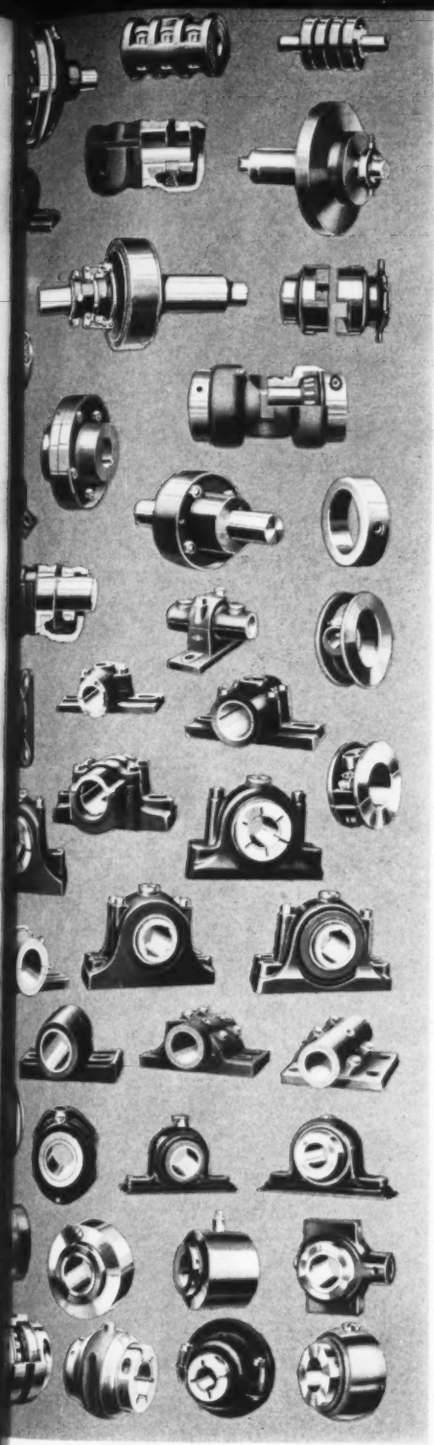

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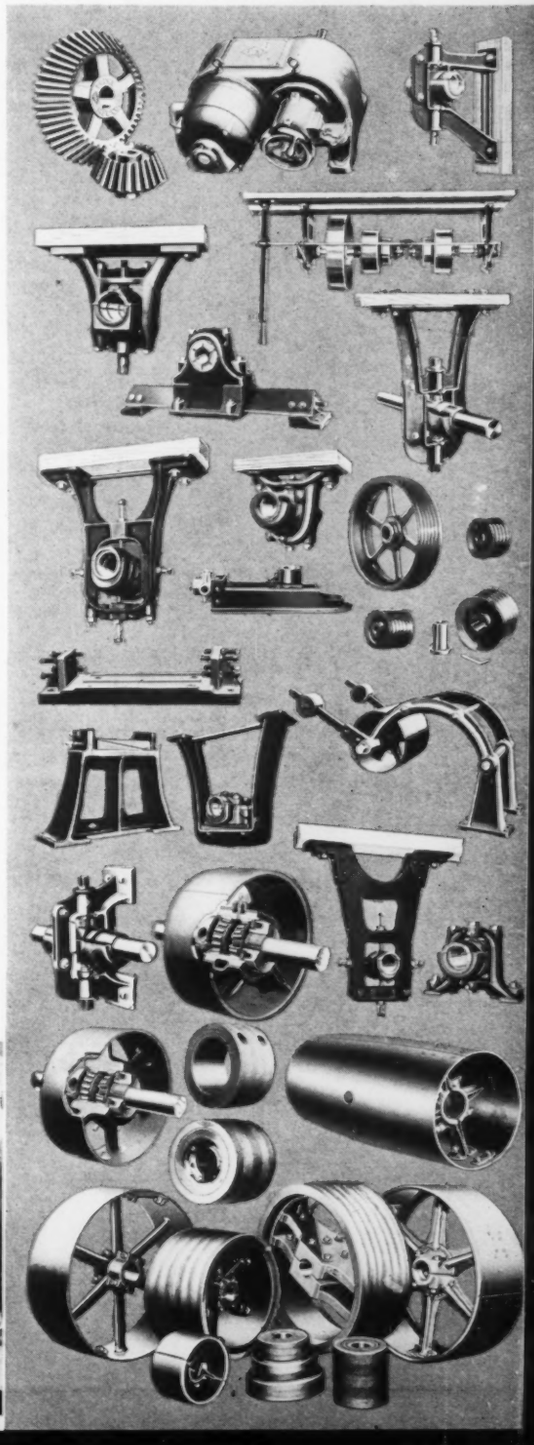

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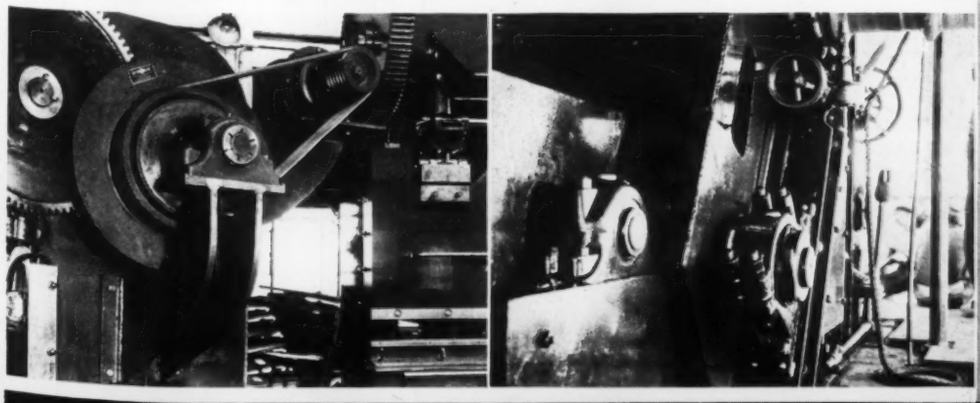
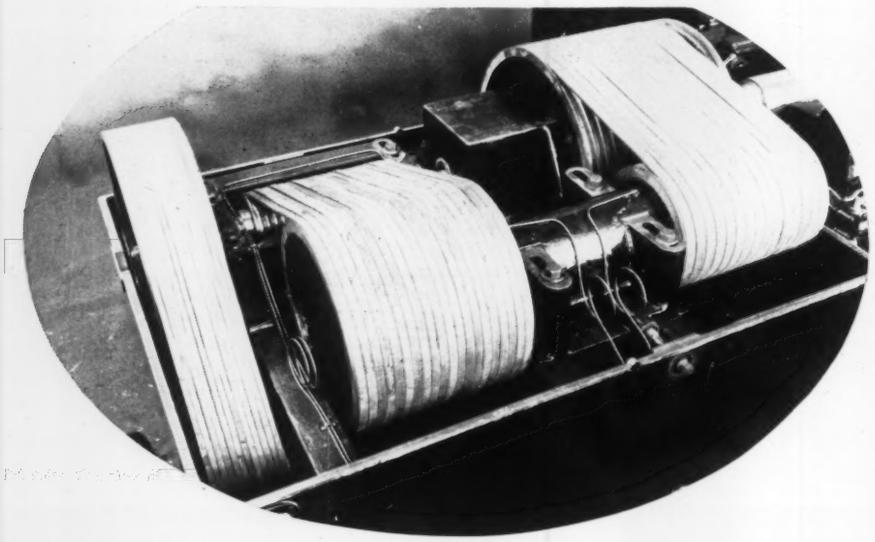


THE Right DRIVE FOR EVERY JOB

Fig. 1—Roll grinder drive utilizes V-belts



New Applications Show Progress in Belt Driving

By Fred B. Jacobs

REDUCED to its simplest terms, a belt drive should transmit the requisite amount of power without undue slippage or excessive belt tension. Other important factors also must be considered. For example, in many instances the design must be such that vibration will be eliminated. Often the type of machine dictates the form of drive. Accessibility also is of importance. That chief engineers and designers as a whole have given the subject careful attention, and have made the most of the advantages disclosed throughout the many years belt drives have been in use, is evidenced by the practical applications discussed in this article.

A good example of a modern multiple V-belt drive is shown in *Fig.* 1 which is the headstock of a 44-inch heavy duty roll grinder built by the Farrel-Birmingham Co. Inc. These machines are employed for finishing steel and chilled iron rolls as used in the steel, paper and other industries. Finishes free from the slightest surface imperfections are demanded; thus an adequate drive wherein vibration is eliminated is imperative.

The driving motor varies from 5 to 25 horsepower depending on the length capacity of the grinder, while the motor speed is from 300 to 1200 revolutions per minute. As *Fig.* 1 shows, an ample number of V-belts is employed. The first, second and third reductions have 12, 20 and 15 belts respectively, and the drive ratios are 5.25, 2.85 and 2.10 to 1 respectively. An important feature pertaining to this drive is that each

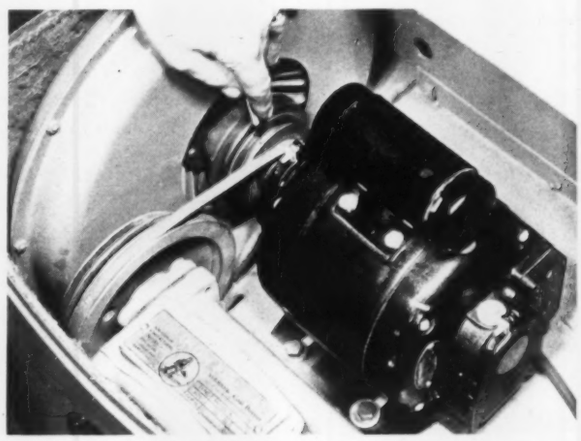
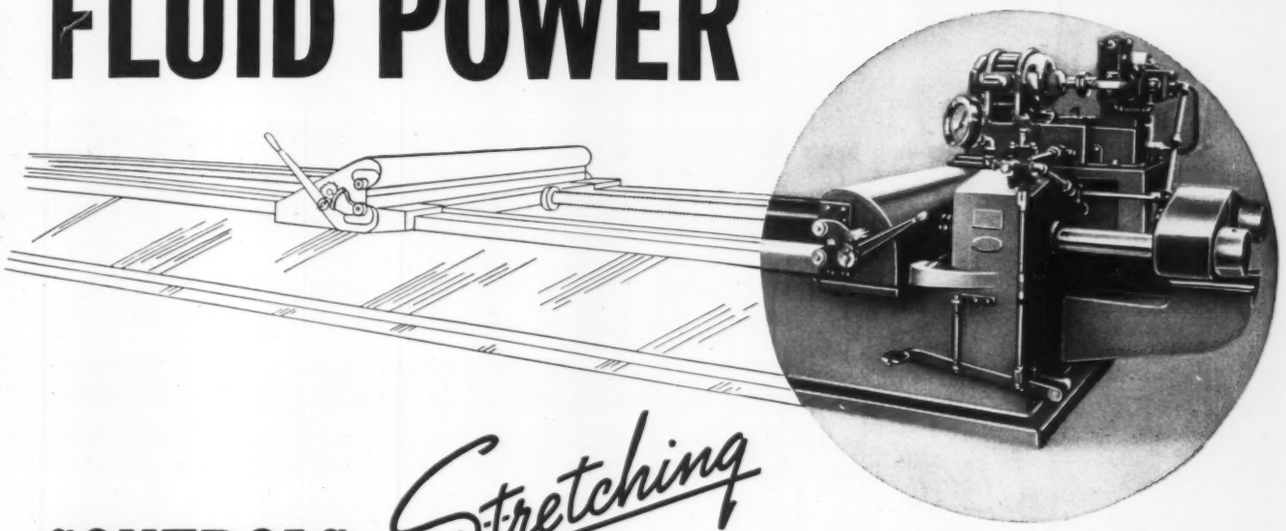


Fig. 2—Quiet and smooth operation is obtained in drive of automatic household stoker

UNCOVER THE FACTS!

FLUID POWER



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Machine designers make use of the controllability of Fluid Power in many ways. For example, a manufacturer of metal-stretching machinery utilizes a Hele-Shaw pump and regulator to proportion the stretching speed to the stretching pressure.

Sheets to be stretched are seized by heavy steel jaws, one of which, the stretching jaw, is hydraulically operated. The stretching jaw travels only a few inches, impelled by a plunger connected to the Hele-Shaw pump. The plunger moves in response to a foot lever.

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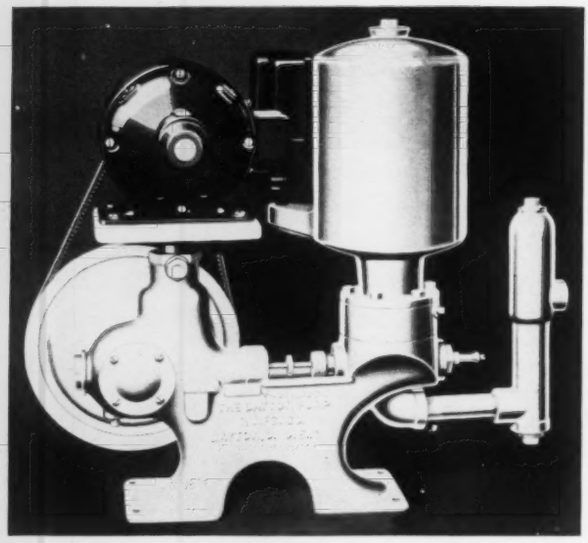


Fig. 3—Simple means for belt adjustment is provided in the support for the motor base

reduction is adjustable separately to give the correct belt tension without the use of idler pulleys. When in use, the drive is protected with a substantial cover which is removed in *Fig.* 1 to illustrate the details.

In *Fig.* 2 is shown a V-belt installation on a household automatic stoking appliance. The entire mechanism is housed to exclude dust but in this illustration also the cover is removed to illustrate the details. The motor feet are slotted to permit belt adjustment, care being taken in the design to make sure that the fan will not hit the case when the motor is moved back its maximum distance. The V-belt drives the stoking mechanism and the object of the 3-step pulleys is to provide different speeds as more coal must be handled in cold weather than when the temperature is mild. This is a good illustration of a small V-belt installation where service must be assured for a considerable time without attention.

The V-belt installation shown in *Fig.* 3 embodies a "cogged" belt used as a pump drive. As the illustration shows, the motor is mounted on a bracket provided for the purpose. The entire bracket can be raised when it is necessary to tighten the belt. For belts of this type it is claimed that they impart a maximum pulling power. Another advantage is that such a drive is quiet in operation.

A somewhat unusual application of a small belt running in grooved pulleys is shown in *Fig.* 4. This unit is a signature engraving machine built by the George Brown Machine Co. The engraving spindle and cutter are an integral unit running in oil impregnated wood bearings, while the drive from the motor is through a small flat rubber belt, not unlike a rubber band. Sufficient gripping power is had to drive the spindle at high speed without vibration, thus making fine engraving possible. As the illustration shows, the drive is from a vertically mounted motor at the back.

Flat leather, rubber or canvas belts in various widths are used for a diversity of purposes for comparatively light drives. An excellent example of this type of drive is seen in some designs of washing machines where the motor and driving mechanism are belt connected. Such belts usually run on flanged pulleys and the motor often has a spring-mounted base to keep the belt in tension at all times. Such a drive will operate for several years without attention.

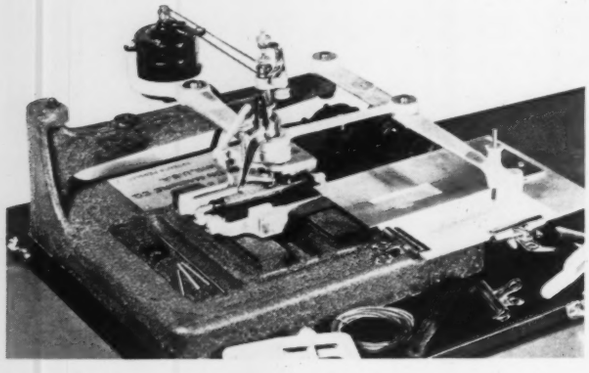


Fig. 4—Vibration, detrimental to performance of engraving machine, is obviated by belt drive

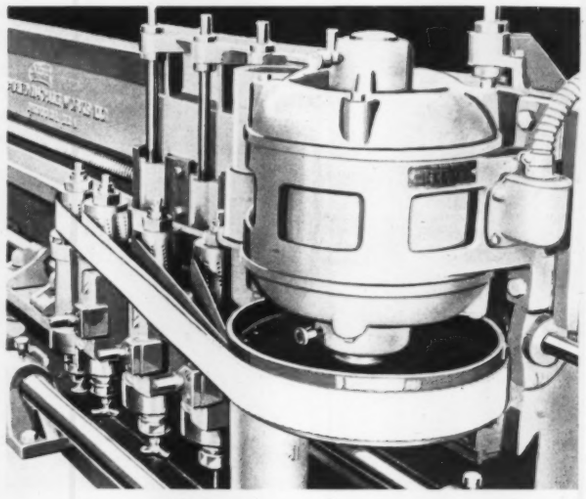
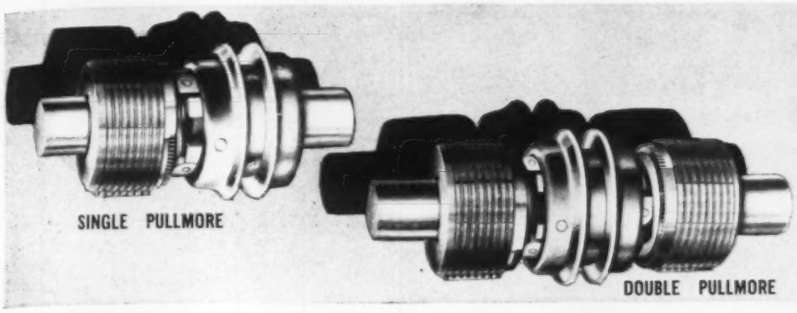


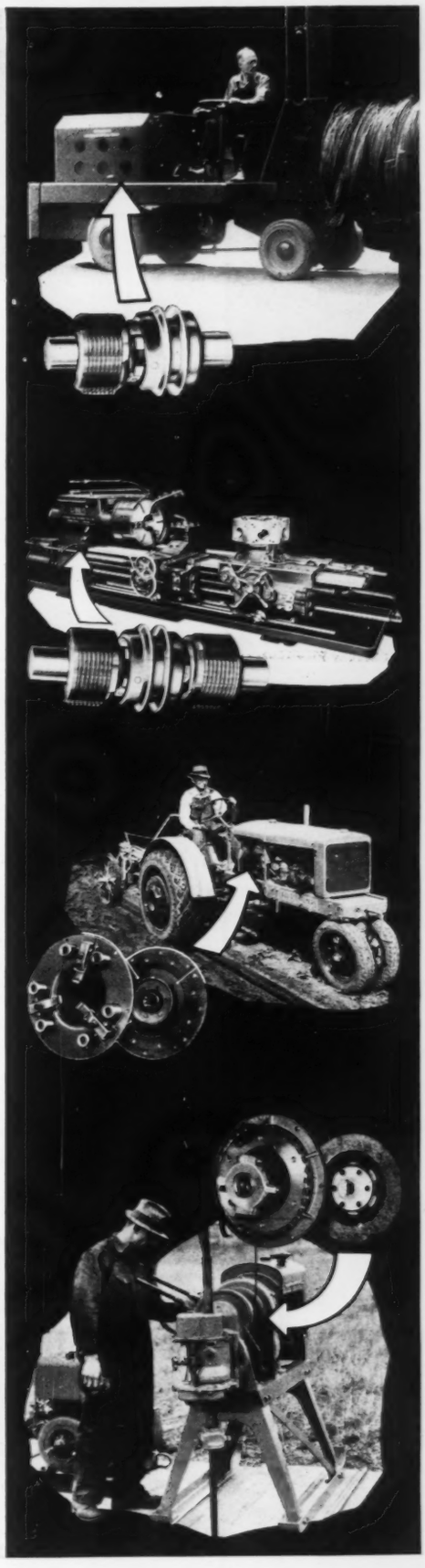
Fig. 5—Four canvas belts drive cutter heads from single driving pulley of woodworking machine

Closely woven flat endless cotton belts are used extensively for driving the high speed spindles used on precision internal grinding machines which run at speeds often in excess of 15,000 revolutions per minute. An endless belt is essential inasmuch as the slightest projecting joint would cause the belt to knock, thus vibrating the spindle. This condition would cause serious defects when finishing precision work.

The vacuum principle is employed effectively on the routing machine shown in *Fig.* 5, which is a product of the Onsrud Machine Works, Inc. As the illustration shows, the pulleys each have a series of holes through their faces. Each pulley is fitted with a centrifugal fan which creates a blast of air, drawn through the

ROCKFORD INDUSTRIAL CLUTCHES



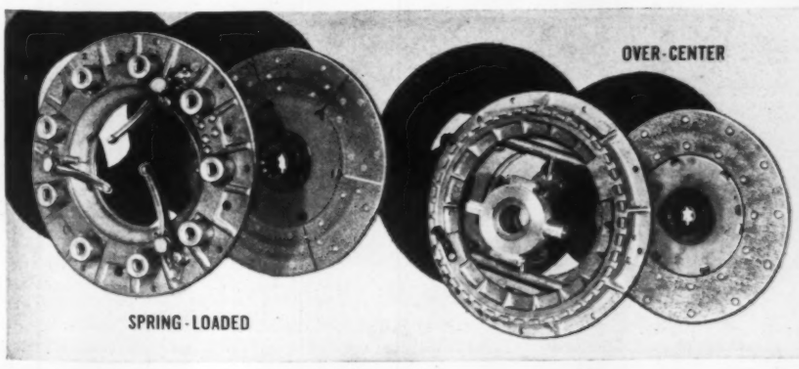


Pullmore Multiple Disc Clutches—Pullmore Clutches are made in single and double types, for operation in oil or dry, in capacities from 2 h.p. to 75 h.p. at 500 r.p.m. They are used in machine tools, cranes, industrial trucks, printing, bookbinding, textile and many other automatic and semi-automatic machines. They are applied as main drive clutches carrying all the load; as auxiliary clutches controlling individual units; and in power take-off mechanisms to operate various attachments. Pullmore Clutches are reliable, compact, readily adapted to design requirements. They engage smoothly, easily; operate efficiently over long periods without attention. Adjustment is simple, can be made easily and quickly when necessary.

Over-Center and Spring-Loaded Clutches—For use in equipment driven by gasoline and Diesel engines we make two types of Rockford Clutches, O-C (Over-Center) Toggle-Type and Spring-Loaded—both interchangeable. O-C Clutches remain positively engaged or disengaged until the position of the operating lever or pedal is changed. Spring-Loaded Clutches operate like an automobile clutch. Both types are available with single or double drive plates, for operation in oil or dry. Sizes range from 6" to 20" diameter for transmitting 2 h.p. to 80 h.p. at 100 r.p.m. Rockford Clutches are used in tractors, agricultural machinery, cranes, road building, well drilling, marine and similar equipment. Arrangement, results to be secured and designers preference determine which type to use.

Engineering Service—Rockford Industrial Clutches are the result of many years of experience in designing and manufacturing clutches of various types for many different applications. The services of our engineering department are available, without charge, to executives interested in efficient, low-cost power transmission and control. Investigate. Write today for complete information.

ROCKFORD DRILLING MACHINE DIVISION
of Borg-Warner Corp., 304 Catherine St., Rockford, Illinois



holes in the pulley. The vacuum thus created causes the pulley and belt to hug closely. In this instance four spindle pulleys are driven by one driving pulley.

Flat leather belts 6 inches wide or more often are used for individual drives designed as integral units with various machines. An excellent example of this practice is shown in *Fig.* 6. This machine is a double-end structural shear. Particular mention should be made of the motor base, the object of which is to provide ample belt tension and also to eliminate burning of the belt in cases where the machine has a high starting torque. The base comprises a seat for the motor mounted on an adjustable support, while springs keep the belt under correct tension. To provide adjustment for elongation of the belt in service the pivot shaft on which the motor support fulcrums is adjustable, two screws being provided for this purpose. When the motor is located below the driving pulley the springs are adjusted to support only that portion of the weight of the motor not needed to provide belt tension. The driven load determines the belt tension required which may be accurately established by the machine operator and changed instantly to accommodate different operating loads. The screws for adjusting the belt tension also provide a ready and efficient means for aligning the motor shaft with the driven shaft.

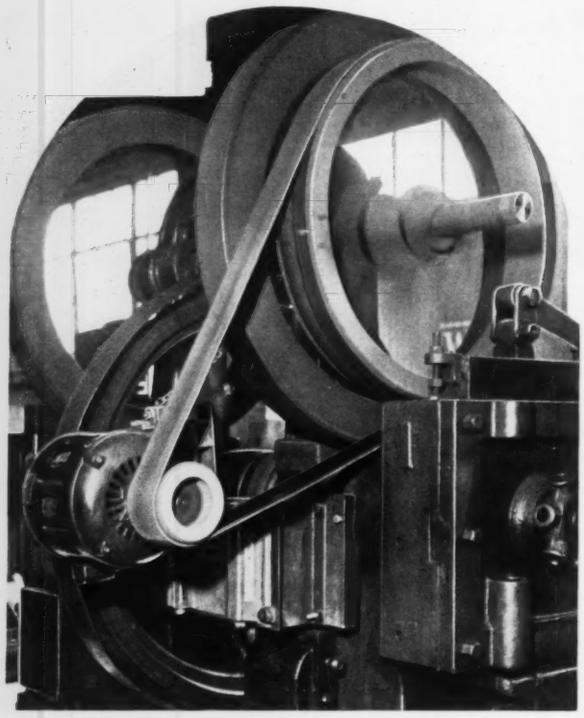


Fig. 6—Special motor base on structural shear insures correct belt tension

Acknowledgment is made to the following companies for their courteous assistance in the preparation of this article: Allis-Chalmers Mfg. Co., George Brown Machine Co., Chicago Belting Co., Dayton Rubber Mfg. Co., Dodge Mfg. Co., Farrel-Birmingham Co., Iron Fireman Mfg. Co., Onsrud Machine Works Inc., and Rockwood Mfg. Co.

"We Drive By—"

(*Continued from Page* 65)

suitable drive speed change mechanism. Standard commercial drive units usually of the friction type, that are quite satisfactory for this purpose are now offered and they are frequently used to advantage in machine tool drives.

Recently Ex-Cell-O Aircraft & Tool Corp. has placed upon the market a hydraulically controlled precision thread grinding machine. In this machine it was necessary to obtain a wide range of work spindle speeds. These speeds were beyond the range that could readily be obtained by the usual speed change devices. It was not considered advisable to use a direct current motor with the associated rheostat for controlling the speeds, since direct current is generally not available in plants where such machines are used, and further because of the possibility of abrasive dust which might find its way into the brushes of the motor. It was necessary to have an exceedingly compact and powerful driving unit that would run smoothly and without vibration that could be mounted directly within the work spindle head.

An entirely new hydraulic speed control was developed. It consists essentially of an automatically variable delivery hydraulic pump direct connected through a flexible coupling to an alternating current motor, mounted on vibration absorbing pads alongside of the machine on the floor. The pump is connected through flexible hydraulic leads to the machine where the fluid delivery is controlled through a panel at the front of the machine. The speed of the hydraulic motor is automatically maintained constant regardless of the load imposed upon it by the work being done.

This method of drive and controlling the speed of a hydraulic motor is rather unique and works out entirely successful since it permits a range of speeds far beyond any that would otherwise be obtainable. The writer believes that in the future such drives will be frequently used in machine tools.

"..... turbines are direct connected."

W. S. Leonard, Chief Engineer

B. F. Sturtevant Co.

WE BUILD steam turbines, electric motors and fans, the fans being our primary product. We seldom have to choose or specify either the means of driving from the turbines and motor, or to the fans. Turbines are almost invariably direct connected to the driven machines.

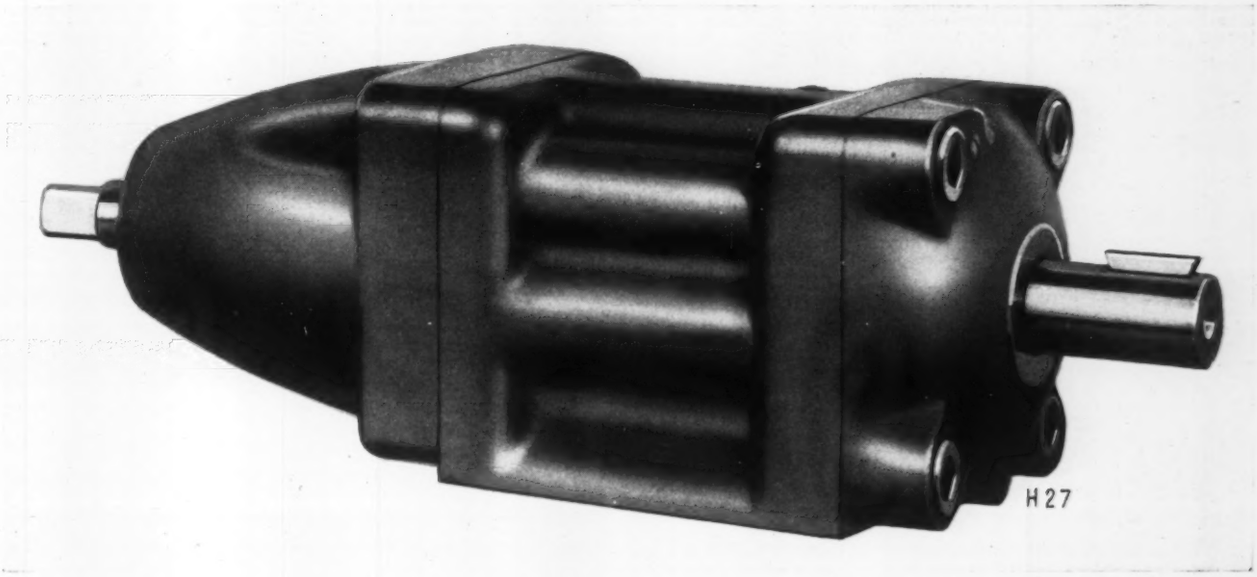
Motors are sometimes direct-connected and sometimes belted. Fans are either direct connected or belted to their drivers. The point, however, that I want to emphasize is that the drive on our type of equipment is nearly always specified by the customer,

ANNOUNCING

Sundstrand

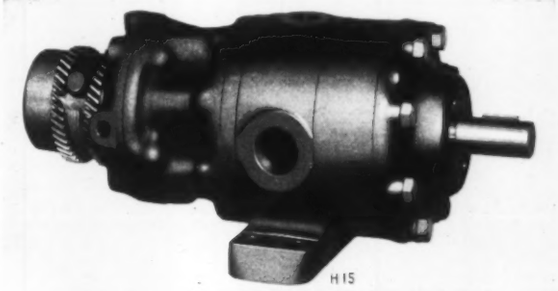
VARIABLE-SPEED DRIVES

FLUID MOTORS—PUMPS—VALVES



Sundstrand Variable Delivery Fluid Motors are compact, powerful, efficient.

Made in various sizes—beginning with a unit delivering 1 h.p. at 900 r.p.m. and measuring 3½"x3½"x10½"—Sundstrand Variable Delivery Fluid Motors give the designer an extremely compact, powerful, efficient means for providing a rotary machine-drive which can be adjusted quickly and easily to any desired rate whatever within specified ranges. Perfectly balanced at 3000 r.p.m.; accurately regulated by manual, automatic or remote control; Sundstrand Fluid Motors form the basis for reliable, durable variable-speed machine drives having new adaptability, flexibility, and easy installation. Constant displacement or variable-volume pumps—both of which we build in suitable sizes—can be used to supply hydraulic pressure for operating Sundstrand Fluid Motors. Investigate! Write today for complete information on Sundstrand Fluid Motors, Pumps, Valves and other equipment for new, more convenient, more effective variable-speed machine drives. Our Hydraulic Engineering Department will cooperate in developing cost-cutting applications of Sundstrand Hydraulic Equipment.



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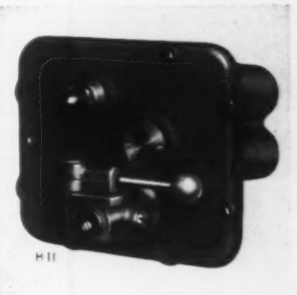
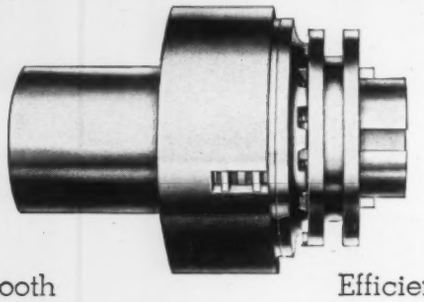
Sundstrand Hydraulic Pumping Units are available for moving slides or other reciprocating machine-elements in automatic or semi-automatic cycles of rapid and one or more slower forward movements, dwell, and quick return, as desired. Jump feed, climb cutting, clutch operating, work-indexing and clamping are a few of many operations performed by Sundstrand Hydraulic Equipment. P W Pumping Unit shown at left, typical control panel at right, others available. Investigate.



Sundstrand Machine Tool Co., *Pump Division*, Rockford, Illinois

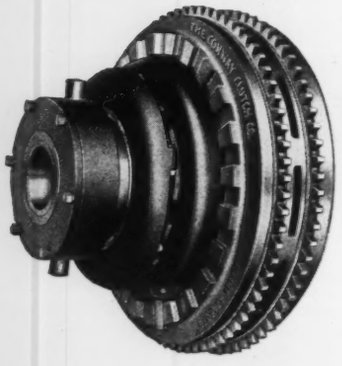
CONWAY Sleeve Clutch



Smooth Efficient

Designed for restricted swing radii and fractional horse powers, all the desirable qualities for which Conway Clutches are famous are incorporated in this new Sleeve Clutch—full floating plates, high ratio leverage, easy engagement, instant release and free idling. Also built to operate double throw.

Write for Bulletin XYZ



FOR HEAVY DUTY

Illustrated: The Conway heavy duty - gear - tooth - driven Clutch. Note its clean, simple design.

Conway Large Size Disc Clutches are as accurately built as the smaller Conways. Drop forged, underslung actuating members exert heavy pressure with little effort. Conway Clutches use—instead of overcome—the effects of centrifugal force.

Send for the Conway catalog No. L28—a Clutch to meet your needs.

SIMPLIFY YOUR CLUTCH PROBLEMS

THE CONWAY CLUTCH CO.

1546 Queen City Avenue
CINCINNATI, OHIO

architect or engineer who designs the general plan, seldom by ourselves.

Fans for severe service, notably in power plants, are usually direct connected and the lighter duty fans for heating and ventilating duty are pretty generally specified with V-belt drives nowadays. I personally prefer a flat belt with Rockwood motor mounting because I believe it is more durable and requires less attention, but I am obviously in the minority, judging from the prevalence of V-belt specifications. This is probably due to commercial rather than technical reasons, as well as to lower costs and more intensive sales methods.

"..... generally adopted V-belt drive."

F. S. ENGLISH, Chief Engineer
Babcock Printing Press Mfg. Co.

MOST printing presses of the sizes which we make are driven by adjustable speed motors with push-button control. The controlling apparatus is, therefore, furnished with the motor and is more or less special in that it is designed particularly for printing presses. The actual drive consequently becomes a very simple problem and in many cases it is an ordinary flat belt. On our rotary presses we originally used silent chain drive but of late we have generally adopted the V-belt drive.

Flat bed presses require considerable variation in power from one part of a cycle to the next, that is the power varies greatly during one cycle of the machine. While not so pronounced, this also is more or less true in rotary presses. We believe the V-belt is desirable for these shock loads. This drive is very simple and is quite universally used except on the smaller sizes of printing presses.

"..... gear transmission is compact."

W. E. SYKES, Consulting Engineer
Farrel-Birmingham Co.

IN THE driving mechanism of the No. 2-C Sykes gear generator, the power is transmitted through a train of gears from a multiple V-belt and motor, to the crank pin which reciprocates the main carriage or ram of the machine. In addition this transmission system drives the feed mechanism and provides four changes of driving speed and four rates of feed.

All the gears are herringbone and the change of speed is effected by gear tooth type clutches which are operated by means of cams. This cam arrangement is such that any speed can be set to figures on a dial in front of the machine. Changes of speeds and feeds therefore are easily made.

This gear transmission, the whole of which runs in oil, operates silently and is compact. It gives positive action and exact gear ratios.

You Get *Quiet, Smoothness,* with FORMICA GEARS

SMOOTH, silent operation results from the proper installation of Formica gears and pinions on machinery of many types. This is a feature that makes machinery easier to sell and is naturally popular with the sales departments of the machinery manufacturers.

Formica, for the same reasons, is a great assistance to the users of machinery and a real friend to the maintenance man who has to keep it operating nicely. Any of the gear cutters named can give prompt service on one or many Formica gears.

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FORMICA

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The Stahl Gear & Machine Co., Cleveland, O.

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Hartford Special Mchny. Co.
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Beaty Machine Works
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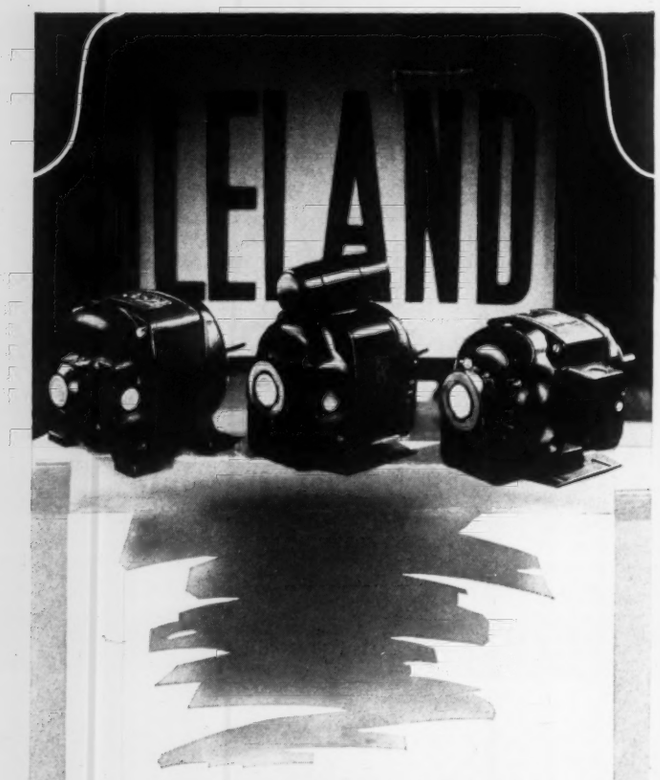

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The buyers of approximately 2,000,000 fractional horse-power motors during 1936 have spoken. They class the Leland motor among the "elite" from the standpoint of design and dealer acceptance.

They place the Leland organization in the topmost bracket when it comes to delivery and field service.

These are the results of a widespread investigation by a disinterested organization. They disclose that when you power your appliance with a Leland you are catering to dealer preference, setting sail before the tradewinds of well-established general acceptance.

THE LELAND ELECTRIC COMPANY

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DAYTON, OHIO, U. S. A.

Cable Address "Leleco"

Chains—Their Application in Machines

(*Continued from Page* 71)

that even if chain elongation takes place—an increasingly important factor when sprockets having more than 120 teeth are employed, the chain will still engage the sprocket satisfactorily without any tendency to ride the teeth.

One desirable use for this special type of chain would be to drive large drums where, with the standard chain, the number of teeth in the drum sprocket might be as high as 500 or even more. With teeth at every tenth pitch this would, of course, be cut down to 50 teeth, and a satisfactory drive for slow speed operation could readily be obtained.

Are Special When First Used

A great number of special drives of this nature have been developed to meet out-of-the-ordinary conditions. These drives are considered special, at least, when first applied. In most cases, however, they prove eminently successful and soon cease to be regarded as special. In this category might be grouped the excessively high speed drives, in which the chain speed far exceeds the normal velocity of 1400 feet per minute and for which both roller and silent chain have been used; the extremely short center distance drives, often utilizing an idler sprocket over which the chain makes a "backward" bend; and the heavily loaded slow speed drives in which the pull on the chain tends to approach the listed breaking strength.

Consideration of drives of this nature and the satisfactory meeting of the conditions by both types of chain goes far to prove the dependability of this form of drive. It also augurs well for the success of the more conventional drive to which, in all probability, more than 99 per cent of the chain produced is applied.

Application Covers Wide Range

Several instances of these more or less normal types of drives are illustrated on the preceding pages. In *Fig.* 1 is shown the use of tiny silent chain of only three-sixteenths inch pitch on a movie projector. Extremely light, the chain is not called on to perform arduous service and consequently does not suffer due to the back bends it takes over the idler sprockets seen in the illustration. Synchronization and quiet running are attained by the use of the silent chain.

Vastly different is the application shown in *Fig.* 2, a speed-increasing generator drive. Roller chain is used

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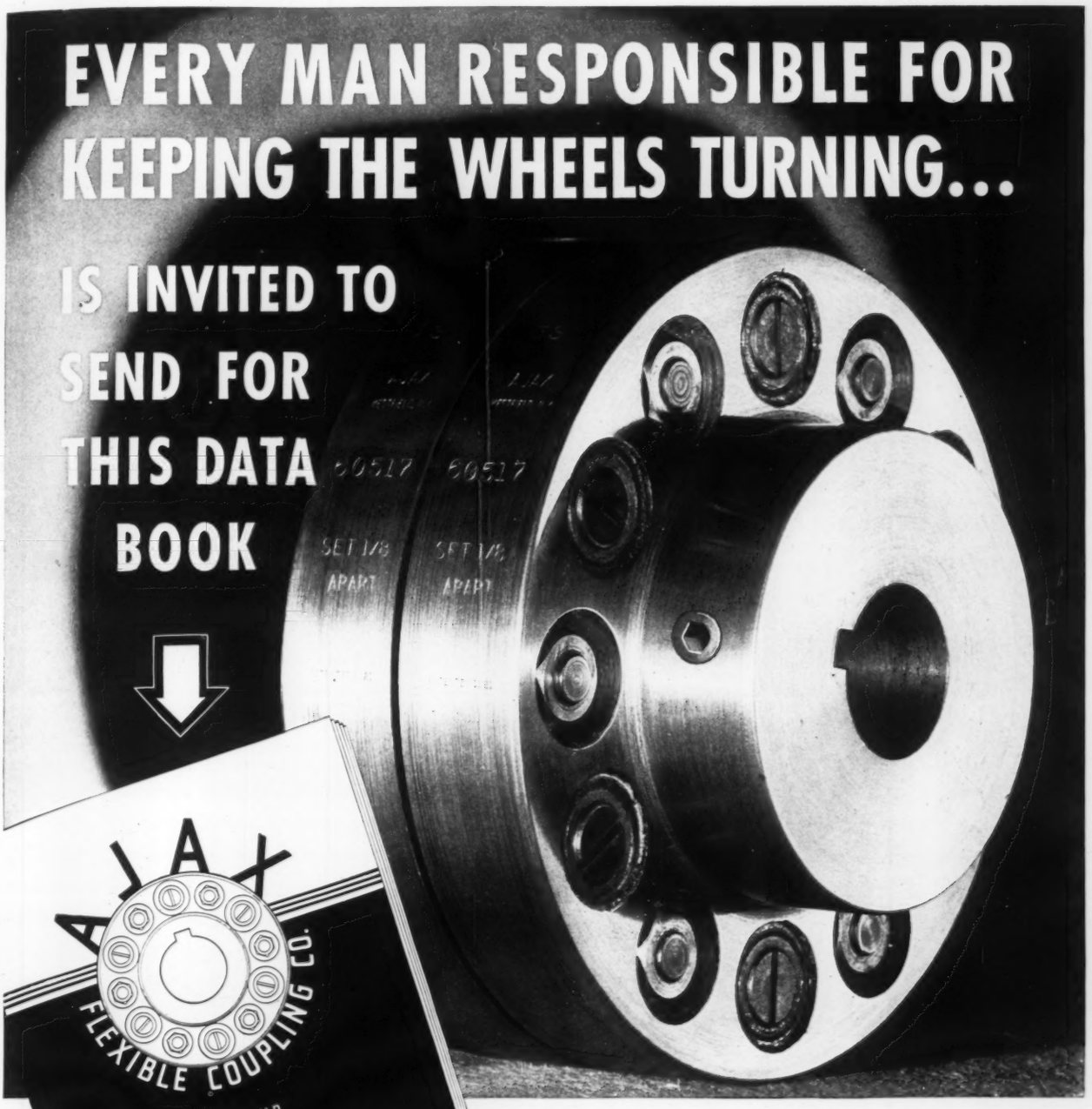

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Every Direct Connected Machine Should be Protected with a Flexible Coupling . . .

This book gives you reference data on Flexible Couplings for use between driving and driven units of direct connected machines. It contains useful technical information covering details of construction, application, load capacity and adaptability of Ajax Flexible Couplings to light, medium, heavy duty and special applications. It shows how Ajax Flexible Couplings protect expensive machinery and keep it running by combining

Positive Drive
Resilient Flexibility
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Peerless motors are available in ratings and sizes from fractional up to 7½ horsepower. Scores of leading machinery manufacturers have standardized on "Peerless."

A large part of the Peerless business is the development of special motors to fit unusual applications. In this field you will find that Peerless can start from scratch and build the complete motor in less time than it takes many to get under way.

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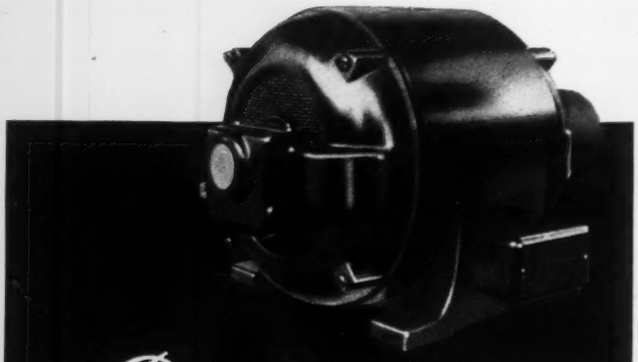


THE *Peerless* ELECTRIC CO.
WARREN, OHIO

in this case, of the multiple strand type. With such a chain it is possible to transmit extremely heavy loads. Short pitch chain is used, thus enabling a compact, quiet and smoothly-operating drive to be designed.

Several single strand chains of the roller type are seen in *Fig.* 3. The versatility of chain is well illustrated in this. Not all the chains are employed for driving purposes, the pair in tandem at the upper right of the picture being used for conveying loaves or packages through the machine, and the two pairs at the lower left performing not only the function of conveying but also of sealing by means of the slat attachments mounted on the chains.

Drive Chains for Conveying

A wide variety of conveying applications of similar nature can be performed by means of attachments riveted or bolted to the chains. As a rule, roller chain is utilized rather than silent because the speed customarily is low and roller chain also lends itself better to the attachment of lugs, slats or other parts used in carrying products through the machine. Continuous conveying platforms as employed in baking ovens and bottling machinery are good examples of application of conveyor chain, as also are the elevating devices used in flour mills and sundry other types of machines in which materials are handled. Many of the chains perform the function of both driving and conveying.

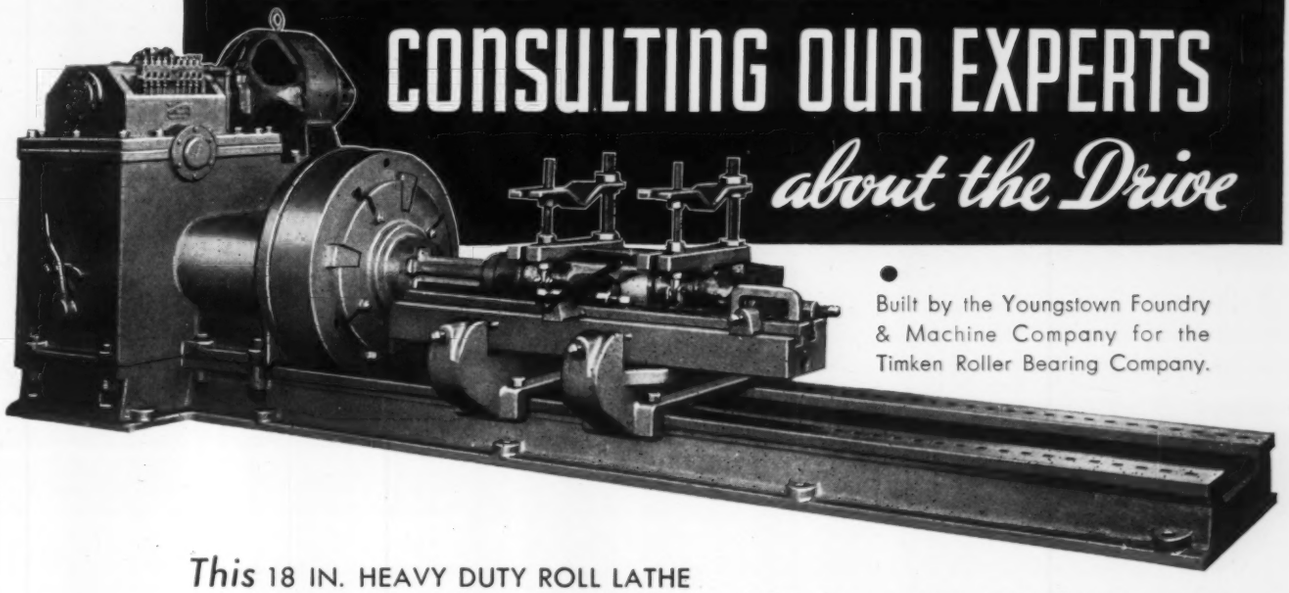
Silent and roller chain drives of conventional type are shown in the other two illustrations, *Figs.* 4 and 5. In both of these cases the drives are adapted to clutch operation by the use of clutches mounted integrally with the driven sprockets. The "building in" of the drives is noteworthy and is indicative of the increasingly active trend in that direction.

MACHINE DESIGN is indebted to the following companies for their considerate assistance in the preparation of this article: Baldwin-Duckworth Chain Corp., Boston Gear Works Inc., Chain Belt Co., Diamond Chain & Mfg. Co., Link-Belt Co., Morse Chain Co., Ramsey Chain Co. Inc., and Whitney Chain & Mfg. Co.

Rubber in Shear Used for Mounting

THOUGH a heavy press blanks out bearing cages with a thump that is quite noticeable throughout a large factory, precision bearing grinders can operate a few feet away and yet not be affected by the vibration. To eliminate the possibility of the press vibration disturbing the accuracy of the grinders, engineers have installed a new type of double shear rubber-to-metal mounting which practically insulates the grinders from other machines in the plant. Work on the grinders is held to within a few ten-thousandths of an inch. Gage readings indicate that not the slightest tremor is transmitted from the heavy presses to the grinding machines because of the newly designed mountings.

You, too, may be able to IMPROVE YOUR DESIGN BY CONSULTING OUR EXPERTS *about the Drive*



Built by the Youngstown Foundry & Machine Company for the Timken Roller Bearing Company.

This 18 IN. HEAVY DUTY ROLL LATHE is reported by the user to be giving highly satisfactory service. Many of its superior features are attributable to the

DE LAVAL WORM GEAR DRIVE

by which two reductions of spur or double helical gears are eliminated and smoother action is transmitted to the face plate. The resulting practical benefits include:

- Smooth, quiet action of face plate because of two less gear trains.
- Smooth cutting action, due to the absence of chatter.
- Two less shafts and four less bearings. (The bearings used are of the Timken roller type.)
- Automatic lubrication; the worm wheel dips in a bath of oil, which is also pumped to the worm and bearings, the latter having automatic sight feeds.

These worm drive roll lathes are available in sizes from 18 ins. to 72 ins.

De Laval worm gears may offer even greater advantages if incorporated in your own machines.

If you will supply information concerning your requirements, our Engineering Department will at once send you the engineering data which you will need in order to lay in worm gears in your design.

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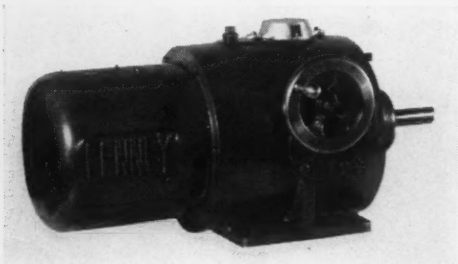
Manufacturers of Steam Turbines, Centrifugal Pumps, Propeller Pumps, Rotary Displacement Pumps, Centrifugal Blowers and Compressors, Worm Gears, Helical Speed Reducing Gears, Hydraulic Turbines and Flexible Couplings. Sole Licensee of the Bauer-Wach Exhaust Turbine System.

POSITIVE and QUIET



DEFINES THE MAJOR PRINCIPLES OF THE NEW LENNEY VARIABLE SPEED TRANSMISSION

ABSENCE of reciprocating parts is responsible for the smooth running of this unit. Variable speed is accomplished by a hardened steel driving disk in pressure contact with a hardened steel roller. An automatic loading device is part of the driving disk which insures that the contact pressure between the disk and the roller be in proportion to the load.

Speed of unit can be changed at any time, either while running or at rest. A dial on top of unit makes easy setting of predetermined speeds. Both input and output shaft are in line—thus providing an ease of installation. The unit will run in either direction, and, operating in a constant bath of oil with ball bearings used extensively, insures long life and freedom from wear.

Furnished with or without built-in motor in sizes from 1/8 to 5 horsepower.

May we mail an interesting catalog — both illustrative and descriptive of this highly efficient driving unit?

THE LENNEY MACHINE AND MANUFACTURING COMPANY

WARREN ● OHIO

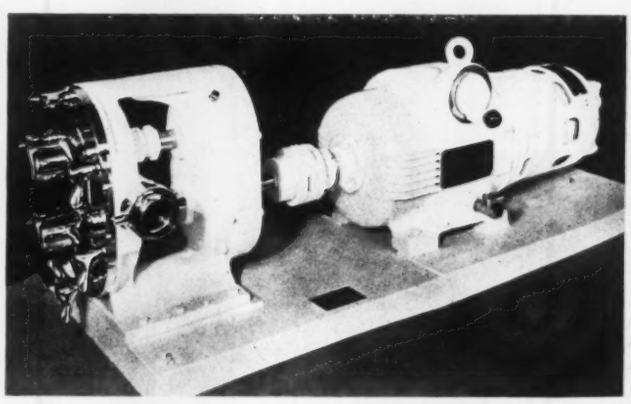
Clutches and Couplings Are Highly Specialized Units

(*Concluded from Page* 76)

is considerable and continuous it may be that some form of universal joint rather than a flexible coupling, is required. Continuous working of the simpler types of flexible couplings at a marked angle should be avoided, and no coupling should be used to compensate for misalignment which can be avoided by better design of the general structure of the machine.

The first clutches commonly to be built into the finer kinds of industrial machinery were those of positive type, embodying jaws, teeth or pins which could be engaged or disengaged by sliding one of the members forward and backward. To avoid shock in engagement, the friction and positive principles sometimes are combined, the load being "picked up" by friction, followed by positive locking when the two members have attained the same speed.

Roller clutches are used to give somewhat more gentle engagement where the collision of jaws or teeth would be too sudden and severe a shock to the mechanism. The roller clutch also lends itself to so-called "free-wheeling" installations where the load should



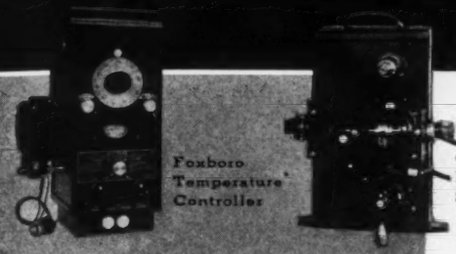
Cushioning effect between variable transmission and pump is attained by drive through flexible coupling

be able to "run away from" the drive under certain conditions. In confined locations especially, where snappy action, nice balance and large load-carrying ability are demanded of a friction clutch, the multiple disk type often is highly desirable. It also is useful when the inertia of the clutch assembly must be low.

All in all, the machine designer should select the simplest type of clutch or coupling which definitely can be depended upon to meet maximum conditions of service throughout the reasonable life of the machine.

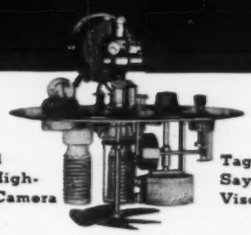
Among those to whom MACHINE DESIGN is indebted for information and illustrations in this article are: Ajax Flexible Coupling Co.; American Flexible Coupling Co.; the Hilliard Corp.; the Miriam Co.; Morse Chain Co.; Rockford Drilling Machine division of Borg-Warner Corp.; and Twin Disc Clutch Co.

A SLOW-SPEED MOTOR FOR EVERY MACHINE

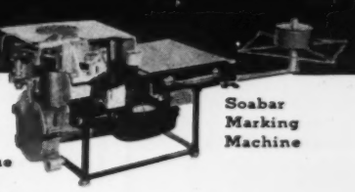


Foxboro Temperature Controller

General Radio High-Speed Camera

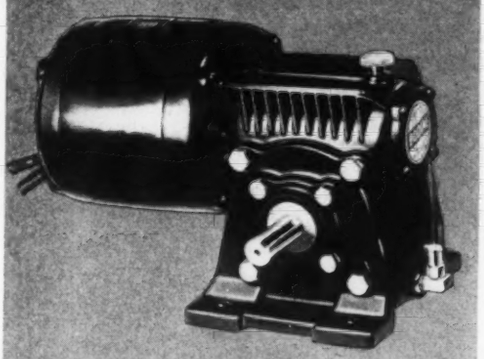


Tagliabue Saybolt Viscosimeter

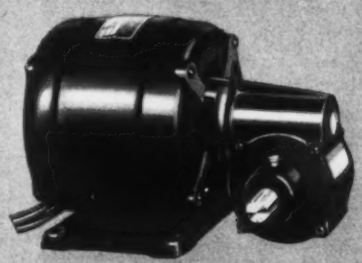


Soabar Marking Machine

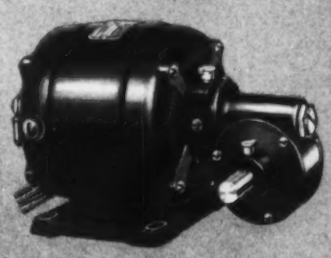
BODINE
SPEED REDUCER MOTORS



Bodine heavy-duty, speed reducer motor with N-5 frame. Reductions 8:1 to 48:1.



Bodine N-5 motor with single reduction speed reducer. Reductions 10:1 to 40:1.



Bodine N-3 motor with single reduction speed reducer. Reductions 10:1 to 60:1.

Bodine N-1 motor with double reduction speed reducer. Reductions 6:1 to 1120:1.

More than 150 types —from 1/500 to 1/6 hp

For fractional horsepower slow-speed motors, consult Bodine. No other manufacturer offers such a complete line. Bodine speed reducer motors are built in every size, every type, and in a wide range of reduction ratios. Several Bodine speed reducer motors are illustrated at the left. These are but a few of the many types of worm gear drives that Bodine offers. They are simple, self-contained, compact, and reliable. The speed reducer unit is enclosed in a machined, grease-tight housing, built into the motor. Accurately ground worms provide smooth, quiet, and efficient operation. Special seals prevent the leakage of oil or the entrance of dirt. These units will give unusually long, trouble-free service.

Bodine speed reducer motors are but part of the complete Bodine line, which includes motors of practically every known type, in ratings up to and including 1/6 horsepower. For over 30 years, Bodine engineers have specialized in adapting these standard motors and in developing special motors to meet individual load requirements. Let them help you solve your motor drive problems. Write Bodine Electric Company, 2258 W. Ohio St., Chicago, Ill.

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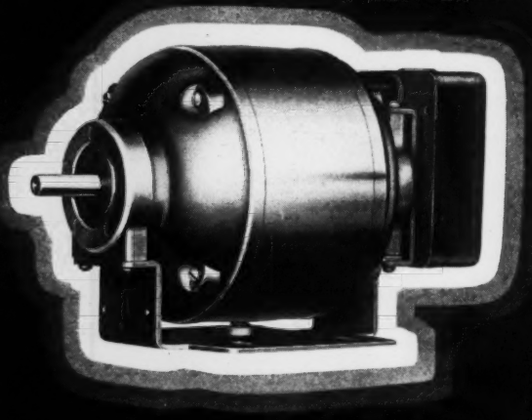
FRACTIONAL HP
MOTORS
ENGINEERED FOR YOUR PRODUCT

BALDOR BUILDS *Better Motors*

for *extra* QUIET OPERATION



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Available in both Split Phase and Condenser types – large and small sizes.

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Sales and Service Offices in Principal Cities

BALDOR
A BETTER MOTOR

Don't Overlook Unusual Methods of Driving

(*Concluded from Page* 80)

quired between it and the turbine, which runs at 1850 revolutions per minute. This is a 74-horsepower machine operating at 150 pounds steam pressure and the exhaust steam is used in a wood-conversion process.

Other machines on which direct steam turbine drives have possibilities are pumps, fans, compressors and blowers — all of which are likely to be closely associated with sources of high pressure steam. That association naturally is the deciding factor on this choice of drive.

Revive Small Steam Units

With the passing of the steam-driven automobile, the small steam driving unit — which had arrived at a high state of development — suffered something of an eclipse. Lately, however, it again has come to the fore as a rival of gas and diesel engines for driving self-propelled railway coaches. This silent, clean and smooth form of power still has its loyal supporters in the automotive field and who can say that the pendulum of design may not sometime swing back to it?

Of the rise of the diesel engine and of the diesel-electric drive, little need be said as far as small central station and streamlined railway train installations are concerned. The present rivalry between steam and diesel engines is one of the most interesting of the many "design contests" which have marked the course of history of mechanical engineering. Use of the diesel engine as an individual drive for fixed or factory-type industrial machines is not yet in evidence. However, with the rapid development of automotive-type diesels in small sizes, no machine designer can afford to close his mind against future possibilities in this direction.

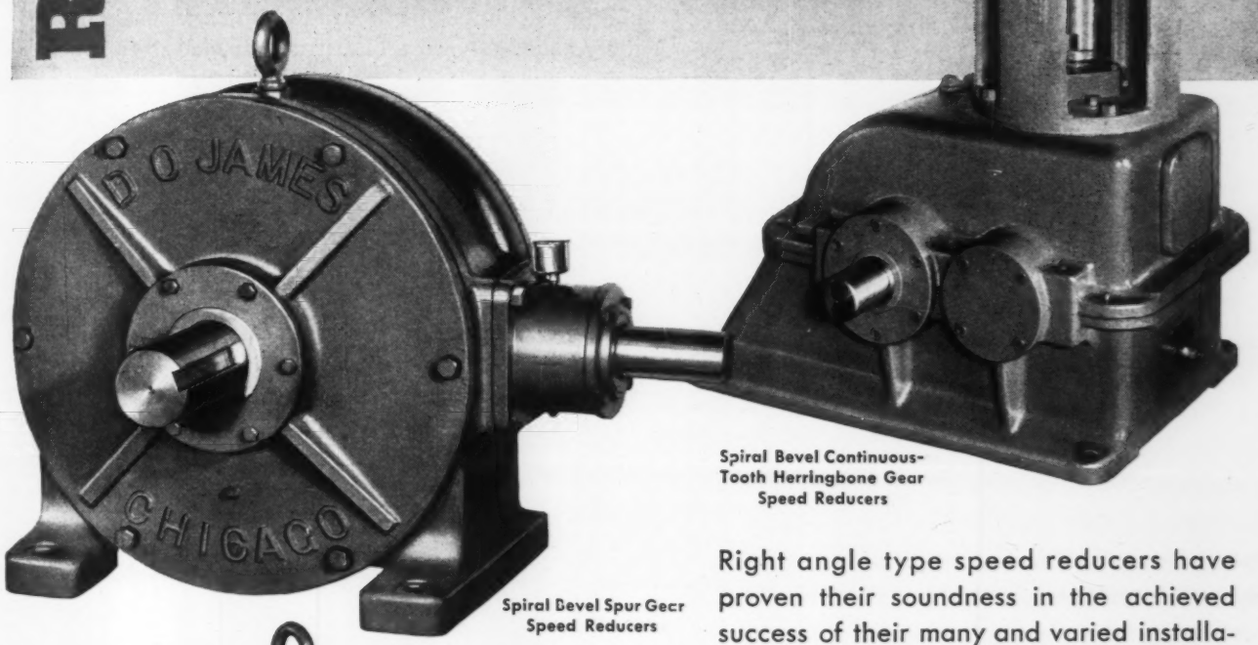
The Challenge of the Diesel

Here and there diesel power is beginning to challenge central station power as means for driving individual machine shops and other manufacturing plants even in the most highly industrialized parts of the country. It is evident that the ultimate industrial subdivision of this form of "packaged power" has by no means been reached. How far the trend will continue no one can foresee.

In the preparation of this article generous help has been given by a number of companies. MACHINE DESIGN takes this opportunity to express appreciation for information and illustrations furnished by the Ariens Co., General Electric Co., General Gas Light Co., Onsrud Machine Works, Inc., S. S. White Dental Mfg. Co. and Wisconsin Motor Corp.

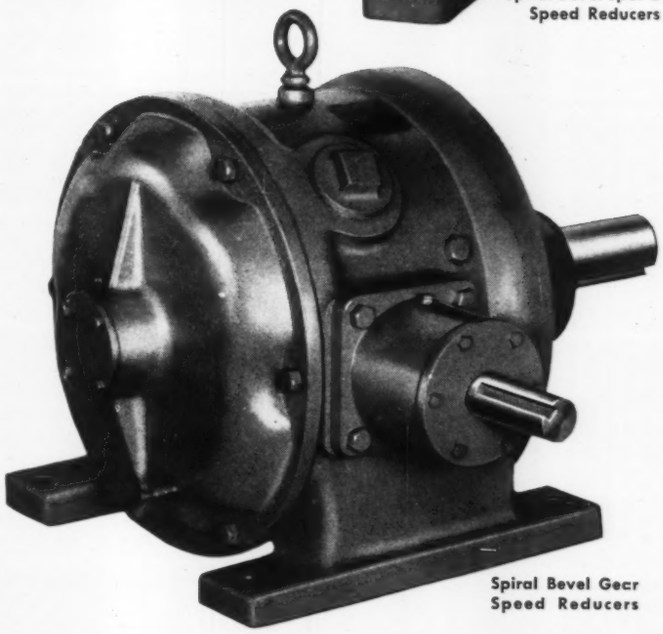
RIGHT ANGLE

- **SPIRAL BEVEL CONTINUOUS-TOOTH HERRINGBONE GEAR SPEED REDUCERS**
- **SPIRAL BEVEL GEAR SPEED REDUCERS**
- **SPIRAL BEVEL SPUR GEAR SPEED REDUCERS**



Spiral Bevel Continuous-Tooth Herringbone Gear Speed Reducers

Spiral Bevel Spur Gear Speed Reducers



Spiral Bevel Gear Speed Reducers

Right angle type speed reducers have proven their soundness in the achieved success of their many and varied installations. Designed and engineered in three different gear styles, and will prove their adaptability on very difficult applications —and when a limited space is available.

Bulletins with complete engineering data are available on these three styles:

- **BULLETIN No. 11**—Right angle Spiral Bevel Gear Speed Reducers with ratios of 1 to 1 up to 6 to 1.
- **BULLETIN No. 16**—Right angle Spiral Bevel Continuous-tooth Herringbone Gear Speed Reducers with ratios of 6 to 1 up to 45 to 1.
- **CATALOG No. 141**—Right angle Spiral Bevel Spur Gear Speed Reducers with ratios of 8 to 1 up to 1200 to 1.

D. O. JAMES MANUFACTURING COMPANY
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D.O.JAMES

FOR ALMOST FIFTY YEARS MAKERS OF EVERY TYPE OF SPEED REDUCER AND CUT GEAR

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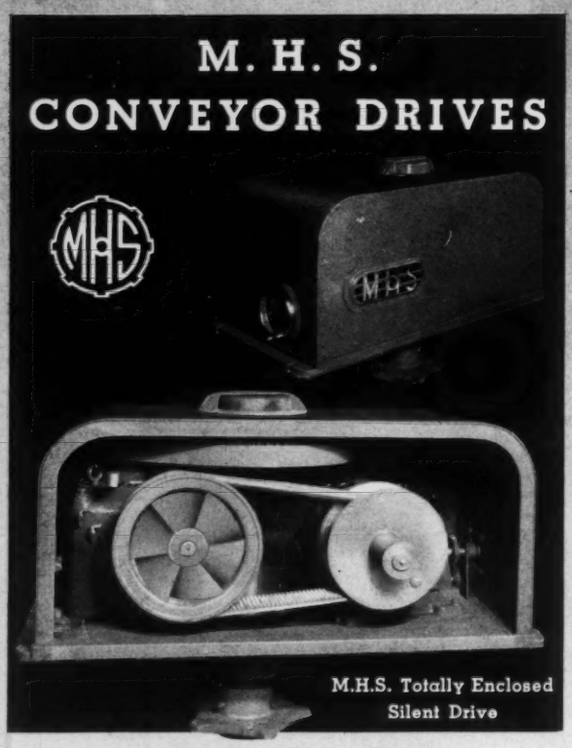

● The M. H. S. Silent Variable Speed Drive for conveyors and other industrial uses, is a compact, well-balanced unit of high torque rating. Power range in standard sizes is up to 7½ H.P. Two distinct speed ranges, each having a variation of 9 to 1 are offered. This unit is made in vertical and horizontal styles.

Standard electric motors — open or closed — may be used. Mounted on a heavy steel base, the unit is completely covered with an easily removable steel casing, sides of which open with a latch. Louvres, and a fan type pulley provide plenty of ventilation. Bearings are standard high grade, anti-friction, pressure lubricated. Shafts are alloy steel. Cut steel gears are reservoir lubricated.

Speed adjustments are made by means of a handle conveniently located outside of the housing, provided with a locking device. Variable speed device has cone pulleys and oversize V Belt.

Write for complete data on these high quality drives

MECHANICAL HANDLING SYSTEMS, INC.
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Patents Relating to Drives

PATENT No. 2,068,645, granted to Clarence A. Henneuse of Bucyrus, O., covers a tractor wheel with treads which conform to the surface over which it passes—whether plane or irregular.

A side view of the wheel is shown in *Fig.* 1 and below the main view is an enlarged section showing the action of the traction elements as they come in contact with the ground. The wheel illustrated is made up primarily of a hub member *A* and a pair of flanged disk members *B* riveted to the hub member. The flanges turn inward and serve to retain in place a number of traction elements *C* sufficient to fill the periphery of the wheel. These nest together with their curved "rolling wedge" surfaces in contact.

The traction elements are of U-shape in cross section and are designed to be built up by bending and welding. At each side is a projecting "ear" *D*. These ears, being inside the flanges of the disks *B*, keep the traction members from falling out of the wheel. It will be noted that the bend of the "U" of the traction element forms the tread, provision being made for attaching the quickly-replaceable rubber pads *E* to the treads.

In addition to the retaining ears *D*, the traction elements also are hooked one to another by bent plates

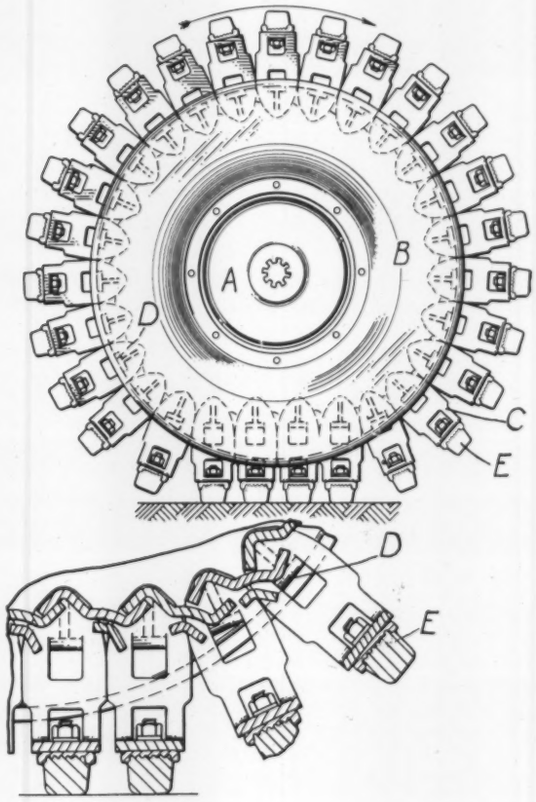
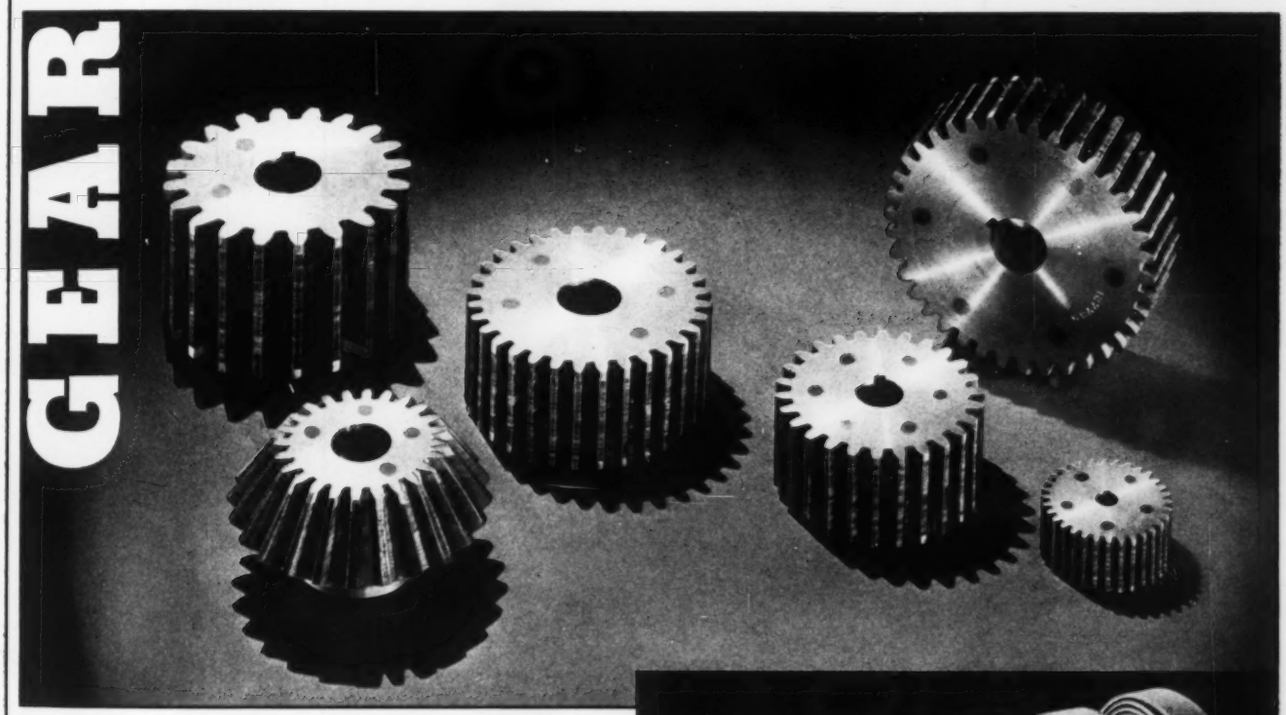
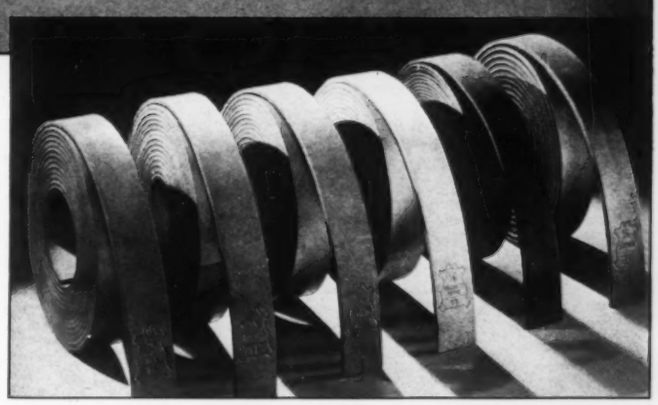


Fig. 1—Crawler effect is attained by floating members interlocked in wheel rim

NOISE IS A COSTLY RACKET

● Gear noise always exacts an unjust tribute. In your own plant it lowers workers' efficiency. In your product it raises sales resistance. And it is by no means a necessary evil. Replace thcse noisy gears or pinions with non-metallic units, (Rawhide, Fabroil or one of the forms of Bakelite) and you eliminate the noise. ● Quiet operation was the objective of Chicago Rawhide engineers in developing the first Rawhide gears that were ever made. Since then other equally important advantages have appeared. The non-metallic pinion not only wears longer but it lengthens the life of the metallic gear with which it runs. Being more resilient it serves as a cushion for impact loads and tends to reduce vibration in machine operation. ● Chicago Rawhide furnishes accurately machined gears and pinions in Rawhide, Fabroil, Bakelite (Formica, Textolite, Micarta, etc.) Cast Iron, Steel and Brass. Gear blanks in any of these materials can also be furnished.





● For 59 years Chicago Rawhide has been a recognized authority on and a manufacturer of power belting. Consult Chicago Rawhide engineers on any transmission problem involving the use of belting or non-metallic gearing.

Chicago Rawhide Mfg. Co.

1304 Elston Avenue

CHICAGO, ILL., U. S. A.

which show in section in the enlarged view at the bottom of the cut. These plates limit the floating action of the traction elements and cause contiguous ones to position themselves consecutively as they come in contact with the road surface. They are so designed that on a plane surface four treads are in contact with the road at one time, as shown in the full view of the wheel. As these four are crowded in, all the others are crowded out to the limit of their radial movement.

When the wheel encounters an obstacle or inclination in the road, an increased number of elements come into contact with the road surface, each perpendicular to its portion of the surface. The wheel thereby "crawls over" irregularities without losing its firm grip.

RECENTLY there has been granted to Arthur E. James of Bidwell, O., a patent covering a novel form of windmill. The design of this motor which breaks away from conventional wind motor design, is shown in *Fig.* 2, which is a transverse section through the relatively tall vertical structure.

The rotor *A* consists of a cylindrical shell mounted on spiders through which the vertical power shaft *B* passes and is locked. The upper end of this shaft runs in a bearing in a tubular post fastened to the top plate of outer casing C, while at the lower end a bevel gear is secured, from which the power is taken off by a bevel pinion on a horizontal shaft.

On the periphery of rotor *A* and extending its full length are fastened longitudinal buckets *D*, the assembly being similar to an overshot waterwheel. Casting *C* covers approximately 180 degrees of the wheel, forming air scoop or lip *E* at one end and being spiraled in to barely clear the buckets at its opposite end *F*. Between the top and bottom plates of the housing at its open

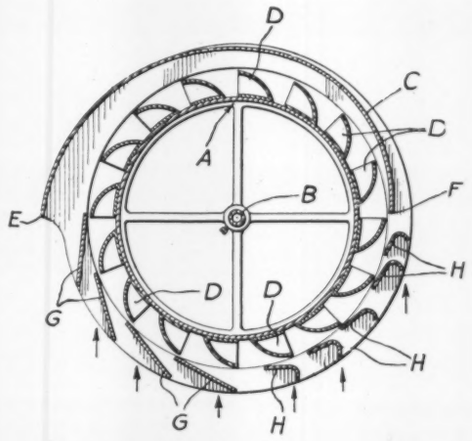


Fig. 2—Vertical wind motor operates on principles similar to water turbine

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Available in 21 sizes. Ratios 5:1 to 2500:1. For 1/30 H.P. to 6 H.P. motors. Timken Bearing equipped. High grade Bronze worm gears and hardened Steel worms run in oil. Completely encased and oil-sealed. Types for continuous or intermittent operation on horizontal or vertical drives.

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The NEW BOND GEAR CATALOG (M 58) contains a complete list of sizes and prices of all BOND STOCK GEARS, SPROCKETS and SPEED REDUCERS and much useful gear information. Be sure to get your copy.

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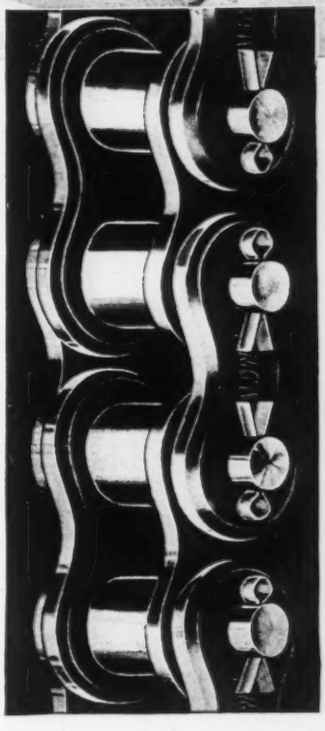


BALDWIN-DUCKWORTH CHAIN

A billion biscuits is a lot of Shredded Wheat, and they flow to your breakfast table through the medium of Baldwin-Duckworth roller chain.

Baldwin-Duckworth roller chain is found in thousands of industrial plants conveying all sorts of products. Conveying and accurate timing mechanism are not the only uses for Baldwin-Duckworth chain. Thus precision machined and carefully heat-treated chain is also an efficient, economical method of power transmission at speeds from 0 to in excess of 3,000 feet per minute.

The 40 years' experience of our engineering department is available without cost or obligation. Send for catalog. Baldwin-Duckworth Chain Corporation, Springfield, Mass.

BALDWIN—DUCKWORTH

side are fastened deflectors, *G* and *H*, the *G* series being flat plates inclined toward the buckets, while those of the *H* series are bent to reverse the direction of the wind current in the direction of rotation of the wheel or rotor.

Assuming that the wind blows in the direction indicated by the arrows in the illustration, a vane "or tail surface", mounted on the previously mentioned tubular post on the top plate of the casing, will have swung the casing into the position shown. The result is that lip *E* and deflectors *G* and *H* cause the current of air to impinge tangentially upon the buckets throughout the greater portion of the periphery of the rotor, thereby causing it to revolve.

This patent is designated by No. 2,059,356.

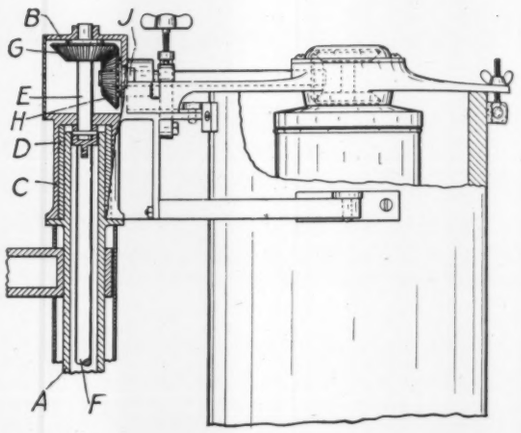


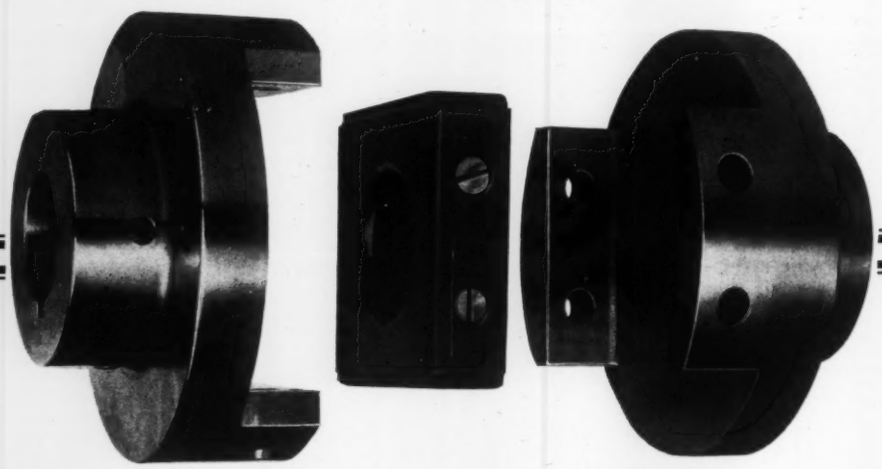
Fig. 3—Power take-off drives attachments from wringer shaft of washing machine

WILBUR J. SMITH of Owatonna, Minn., has developed a power take-off system by means of which a washing machine becomes the source of power for driving various household mechanisms. This invention is covered by patent No. 2,058,920.

The use of this system for driving an ice cream freezer from the wringer power shaft is depicted in *Fig* 2, which is a side elevation in partial section. On the vertical tubular wringer post *A* of the washing machine there is mounted a gearcase *B*. This is provided with a flanged extension *C* fitted with an adapter sleeve *D* to make it fit the wringer post, which is, of course, of varying size on different machines.

Within the gearcase is vertical stub shaft *E* which is designed to clutch into the upper end of the wringer power shaft *F*. At the upper end of the stub shaft is keyed a bevel gear *G* meshing with another bevel gear *H* keyed to horizontal take-off hub *J*. This hub embodies a driving lug by means of which the horizontal driving shaft of the attachment can be connected.

AMERICAN FLEXIBLE COUPLINGS ARE CORRECT IN PRINCIPLE AND DESIGN



THE AMERICAN Flexible Coupling, an improved application of the well known Oldham principle, provides complete flexibility without the use of flexible materials. There is no binding or cramping under misalignment, and ample provision is made for end float. This reduces power loss. Wearing parts are replaced without taking coupling apart. Both primary and secondary lubrication are provided. Replacement of the entire center block is unnecessary, as non-metallic wearing strips cut expense of installation to a minimum. May we mail a copy of our late catalog descriptive and illustrative of both light and heavy duty types?

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If the power drive is SKF-equipped, it assures power transmittal with the least possible waste. For SKF reduce power losses, maintenance costs, lubrication, and insure *all* the power all of the time.

Easy to install and maintain on shafts from 5/8" to 30" in diameter, SKF Bearings usually pay for themselves within two years. Ask your nearest SKF distributor for our special bulletin, "SKF Ball and Roller Bearing Transmission Appliances."

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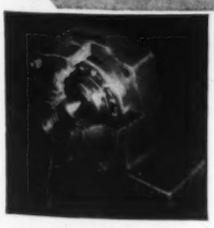
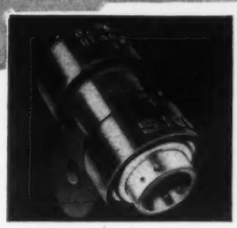
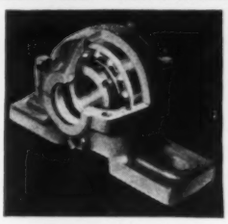


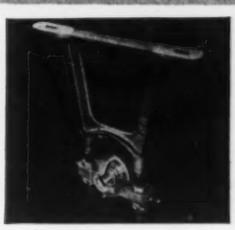
• *Universal Pillow Block*



• *Knee Type Blower Box*



• *Type SP Pillow Block*



• *Drop Hanger*

• *SA Type Pillow Block*

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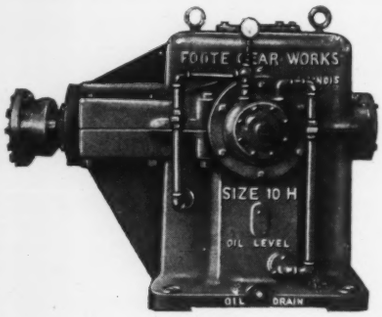

Installed by Worthington Pump and Machinery Corp.—Between a Diesel engine and Duplicate reciprocation power pump in a job at Artesian, New Mexico.

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Machine Drives Supplement

APRIL 1937

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Today, increasing demands are made upon all types of production machinery. The designer is called upon to provide utmost simplicity in operation, freedom from frequent tie-ups, finer, unfailingly continuous, more economical performance. ● For gears, bearings and scores of other applications in many types of production machines, INSUROK is employed with ontstanding success. Send for complete details and copy of INSUROK Handbook.

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Chief Engineers, Designers Demand Data in Readily-Available Form

ENGINEERS responsible for design have certain distinctive qualities and, we must admit, some uncommendable traits. Of the favorable qualities, sound and orderly thinking probably ranks first in point of professional assets—for after all one cannot lay out a new machine, except by rare mischance, if one's thought are haphazard. Nor can a designer apply the proper analytical approach to his everyday problems unless he has developed an aptitude for exactness and order.

Granted that the designer on the board, when promoted to the more administrative position of chief engineer or director of design, necessarily becomes more far-sighted in his outlook, his thinking still is influenced to a considerable extent by the habit of deep concentration built up through earlier years.

It was in the knowledge that most design executives and designers run true to the type portrayed in the foregoing that MACHINE DESIGN, their professional journal, was originally conceived as a magazine that must—first and foremost—be orderly in its presentation of editorial contributions and in its layout of pages. Further, that it must be departmentalized to a point that would enable a busy reader to look over without loss of time, and to file if desirable, those sections holding the most immediate or prospective interest for him.

In the current issue, and in several previous numbers in which special supplements were included, this thought has been carried a step further. The supplement on machine drives which is presented on the buff-colored pages immediately preceding this is devoted solely to machine driving equipment. Preparation of this supplement has been no easy task. It was planned months ahead, and since that time the editors have been collecting and correlating details on developments in driving methods in order to present to readers the latest and best information available.

Other supplements to MACHINE DESIGN's regular issues have covered machine tool design, welding, and materials (the last of the latter including the fourth edition of the directory of materials used in design of machines). All of these have been stitched separately and stapled into the regular issue with which they were published, this form of binding being adopted to enable the reader to detach the supplement from the issue if he wished to file it for reference.

Plans have been laid for a continuance of these special supplements at periodic intervals. The next is scheduled for October and will include the fifth edition of MACHINE DESIGN's Directory of Materials. Others suitable for filing will be published on subjects such as engineering department equipment, hydraulic and electric controls, bearings, etc., with the object of assisting the engineer responsible for design to build up a permanent and valuable reference file on specific design subjects in addition to his file of regular issues.

MEN of MACHINES

HARRY T. WOOLSON made a name for himself in marine engineering prior to the brilliant automotive career which has made him executive engineer of the Chrysler Corp. and president of the Society of Automotive Engineers.

After graduating in mechanical engineering from Stevens Institute of Technology in 1897, he became a draftsman at National Meter Co. During the Spanish-American war he served six months in the navy, and for sixteen years thereafter specialized in marine motor design. He entered the automotive field in 1915 as truck engineer with Packard. At Studebaker in 1916 he met Fred Zeder, Carl Breer and Owen Skelton, with whom he joined Walter Chrysler at Willys in Elizabeth, N. J. in 1920. When the Chrysler Corp. was organized, he became its chief engineer.

HARRY T. WOOLSON

• • •

AWARD of the Schoellkopf medal of the American Chemical Society to James G. Marshall of the Union Carbide Co. and associated Electro-Metallurgical Co., is a fitting tribute to one whose work has been of great importance to mechanical engineers.

Shortly after his graduation from Pennsylvania State college in 1896, Mr. Marshall joined the Union Carbide Co. For forty years his inventive and engineering ability have been devoted to technical improvements in the calcium carbide and ferro-alloy industries and in utilization of their by-products. These technical developments include reciprocating drag conveyors, electric furnaces and acetylene generators. He has always been steadfast as a proponent of improved working conditions. Since 1921 Mr. Marshall has been general superintendent of operations.

JAMES G. MARSHALL

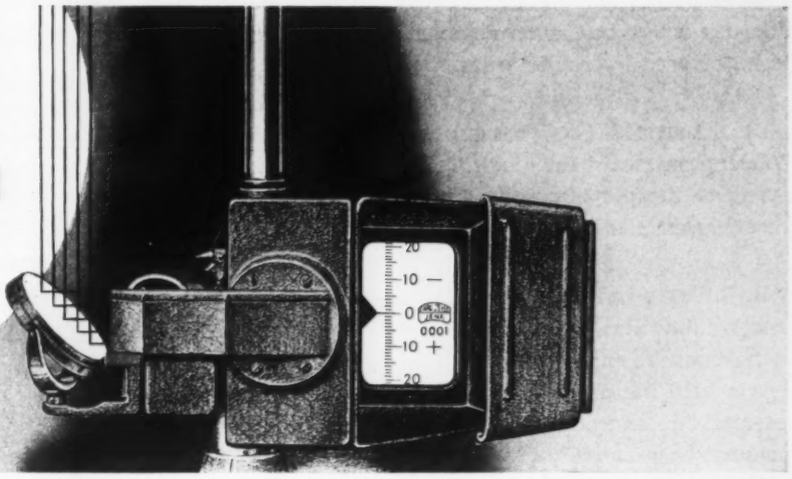
• • •

LONG recognized as an authority on the design of hydraulic presses, testing machines and special equipment—especially that dealing with high pressures—Richard W. Dinzl has now been made chief engineer of the Watson-Stillman Co., Roselle, N. J.

Mr. Dinzl was born in Vienna, Austria, in 1889, attended school in that city, and graduated from the University of Vienna with a degree in mechanical engineering. He came to the United States in 1913 and his first connection in this country was with R. D. Wood & Co. of Philadelphia, where he gained valuable experience on the design of presses and other hydraulic machinery. After two years with them, Mr. Dinzl went with the Southwark Foundry and Machine Co. as designing engineer. He remained with Southwark for twenty-two years, being appointed chief en-

RICHARD W. DINZL

THE LENGTHENING SHADOW OF AN IDEAL



AMERICAN tools owe their world leadership to precision standards that have been constantly improved year by year. Almost every important machine tool plant existing today is a direct descendant of one of the half dozen pioneer builders.

In the same way, M-R-C Super-Precision Ball Bearings are the result of the precision standards established by pioneer leaders in this field over 39 years ago. Eleven of the recognized ball bearing types in use today were originated by these men whose ideals are continued in M-R-C plants and methods.

M-R-C Super-Precision Ball Bearings give several thousand hours of life on production spindles running 40,000 r.p.m. Every ball at such speed actually turns at better than 80,000 r.p.m. — and to permit this must be accurate in size and sphericity to within a few millionths of an inch.

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gineer of the company in 1918. During his many years of service in that organization he designed a large number of unusual pieces of equipment and was particularly active in the development of the modern type of high speed hydraulic press.

♦ ♦ ♦

DR. FREDERICK G. COTTRELL has been presented the Washington award for his " . . . . social vision in dedicating to the perpetuation of research the rewards of his achievements in science and engineering."

♦ ♦ ♦

R. B. FEHR has been put in charge of engineering at Una Welding Inc., Cleveland. Mr. Fehr, who graduated in mechanical engineering at Pennsylvania State college in 1910, has devoted much attention to experimental research in connection with industrial development of welding.

♦ ♦ ♦

HARLAN W. HOW, formerly chief engineer of the Buffalo Foundry & Machine Co. and lately consulting engineer of the Blaw Knox Co., has rejoined the staff of the Struthers-Wells-Titusville Corp. as technical director.

♦ ♦ ♦

ROBERT F. VOGT, assistant chief engineer of the Allis-Chalmers Mfg. Co., Milwaukee, since 1921, has been promoted to chief consulting engineer, succeeding J. F. Max Patitz whose death was noted on Page 57 of the February issue of MACHINE DESIGN.

♦ ♦ ♦

WILLIAM A. PURTELL, president and general manager, Holo-Krome Screw Corp., Hartford, was recently elected president of the Billings & Spencer Co. His active connection with Holo-Krome continues unchanged.

♦ ♦ ♦

J. C. JOUBLANC is now chief metallurgist of the Harnischfeger Corp., Milwaukee. Mr. Joublanc has for many years been active in metallurgical and welding research.

♦ ♦ ♦

PAUL E. FRIEND has been made chief engineer of the Wilkening Mfg. Co., Philadelphia, with whom he has been connected since graduating from the University of Pennsylvania in 1932.

♦ ♦ ♦

E. J. RAMALEY has been appointed to the technical staff of the Battelle Memorial institute with the assignment to conduct research upon magnetic properties of alloys.

♦ ♦ ♦

FLOYD A. BEATTY, vice president in charge of engineering, Lewis Foundry & Machine Co., Pittsburgh, has been made operating vice president.

♦ ♦ ♦

PAUL W. K. MENARD has been appointed chief metallurgist at the Wood works of the Carnegie-Illinois Steel Corp., McKeesport, Pa.

♦ ♦ ♦

B. F. JONES is now chief engineer of the Indiana division of the White Motor Co.

Obituaries

PROF. ELIHU THOMSON, 83, pioneer in the modern electrical industry and a founder of the General Electric Co., died at Swampscott, Mass., on March 13.

Although best known to the present generation for his developments in the resistance method of electric welding, which he originated in 1887, Professor Thomson was also one of the early arc light inventors, an early exponent of alternating current transmission, developed the repulsion type of induction motor and invented the magnetic blow-out type of switches and lightning arrestors. He held upward of 700 patents in the United States alone.

Professor Thomson, who was born in England, organized the Thomson-Houston Electric Co. in 1883. In 1892 this was merged with the Edison General Electric Co., forming the General Electric Co., of whose staff of scientists the founder lived to become the dean.

♦ ♦ ♦

EDWARD P. BURRELL, director of engineering of Warner & Swasey Co., Cleveland, died on March 21 after a brief illness.

Mr. Burrell, who was born at Hall, N. Y., in 1871, was a mechanical engineering graduate of Cornell university. He joined the Warner & Swasey Co. in 1900, serving successively as a designing engineer, works engineer and works manager until 1924 when he was made director of engineering. His work covered not only the design of turret lathes but also of astronomical telescopes, including the recently completed 82-inch McDonald telescope for the University of Texas. Mr. Burrell had been granted many patents covering important developments in the fields in which he was so long engaged.

In addition to his M. E. and M. M. E. degrees from Cornell, he was awarded an honorary degree of Doctor of Engineering by Case School of Applied Science last June.

Sleeve BEARING DATA

Selecting the Alloy

The many and various applications of sleeve-type bearings make necessary the availability of a variety of bearing metals possessing many distinctly different properties. Each particular bearing metal must be best suited for those conditions of service wherein its outstanding characteristics will be of greatest advantage. Accordingly, in the selection of a bearing material it is necessary that the service conditions and the destructive forces on the bearing be analyzed first and the bearing material be then selected for that specific application.

All bearings operate in direct contact with the shaft, until the creation of the necessary film of lubricant. This point must also be considered in selecting the proper alloy. The following physical properties govern the suitability of a bearing metal: (1) Plasticity; (2) Ability to Resist Wear; (3) Coefficient of Friction; (4) Compressive Strength; (5) Resistance to Pounding; (6) Toughness.

Listed below are three popular alloys of Johnson Bronze. Compare their variance in characteristics. Remember, however, that each of these were designed to suit certain operating conditions.

Johnson Alloy 29

S.A.E. 67

Copper 78 Tin 7 Lead 15

Tensile lb. per sq. inch ± 5000	24,000
Proportional Limit ± 2000	7,600
Yield Point lb. per sq. inch ± 3000	16,400
Elongation in 2 inches	9 ± 4
Brinell Hardness No.	52
Wear Rate (dry)	0.35
Coefficient of Friction (dry)	0.16
Izod Notch Toughness	5.6
Resistance to Pounding	40

This is a high lead alloy and is valuable as an acid-resisting bearing bronze. Its plasticity is particularly valuable when used with soft shafts at high speeds because it conforms itself readily under comparatively light loads.

Johnson Alloy 27

S.A.E. 64

Copper 80 Tin 10 Lead 10

Tensile lb. per sq. inch ± 5000	30,000
Proportional Limit ± 2000	9,700
Yield Point lb. per sq. inch ± 3000	19.000
Elongation in 2 inches	10 ± 5
Brinell Hardness No.	58
Wear Rate (dry)	0.32
Coefficient of Friction (dry)	0.19
Izod Notch Toughness	4.4
Resistance to Pounding	63

Universally accepted as the ideal alloy for all general purpose applications. Possesses ample load carrying capacity with a relatively low coefficient of friction.

Johnson Alloy 53

S.A.E. 63

Copper 88 Tin 10 Zinc 2

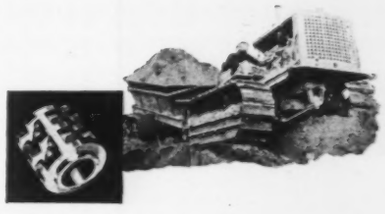
Tensile lb. per sq. inch ± 5000	36,000
Proportional Limit ± 2000	13,000
Yield Point lb. per sq. inch ± 3000	19,000
Elongation in 2 inches	18 ± 4
Brinell Hardness No.	69
Wear Rate (dry)	0.62
Coefficient of Friction (dry)	0.26
Izod Notch Toughness	8.5
Resistance to Pounding	86

A good tough bronze for heavy duty service where abrasive action takes place or when vibration or shock are encountered. Requires a hardened steel shaft and proper lubrication.

The electric motor offers a good example of the necessity for a high lead bronze. High speeds, continuous overloads, misalignment of shafts and microscopic irregularities on the bearing surface are factors to consider. An ample supply of lead provides conformability and prevents a galling or plating action on the shaft. Sleeve-type bearings have long remained the distinct favorite of electrical engineers due to their long life and efficient service.

Engineers and Designers

This is but one of a series dealing with the facts concerning sleeve-type bearings. The complete series will be forwarded if you will write us, giving your firm name and title. We also solicit your inquiries regarding any type sleeve bearing. Our engineering facilities are available to you without obligation.



The tractor illustrates the need of a bearing material suitable to withstand pounding action, resistance to abrasives, etc. Dust, grime and grit are ever present. At the same time, the heavy service required of the machine places excessive shock on the bearing parts. This is but one of the many bearing problems successfully solved by Johnson engineers.

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Sleeve BEARING HEADQUARTERS

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The bus interior, illustrated, is typical of bent tube work done in Wellman's tube finishing department, and the noticeable quality of the plating is what can be expected when Wellman does the job.

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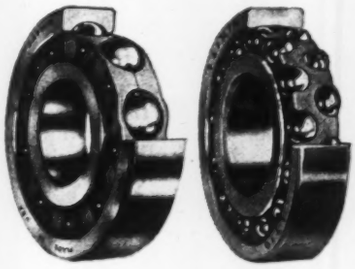
NEW Materials and Parts

Bearings Are Suited for Heavy Loads

TO MEET the severe problems of shock loads, vibration and wear coincident with the operation of heavy duty machinery, Fafnir Bearing Co., New Britain, Conn., has recently added a new series of high capacity ball bearings to its present extensive range of types and sizes. Using as a basis the single



Specially designed wear-resistant bronze retainers meet extra duty requirements in bearings

row radial design, the new bearings are furnished in the heavy duty series with specially designed sturdy, wear-resistant bronze retainers to take care of extra duty requirements. Rugged and accurately fabricated to be exactly balanced in operation, the new series fulfill all demands imposed on this type of equipment.

Fluid Motor Line Is Introduced

A NEW line of multiple piston-type fluid motors has been introduced by the Sundstrand Machine Tool Co., Rockford, Ill. The first unit to reach the market has a rating of one horsepower at 900 RPM and is

Fluid motor developed one horsepower at 900 RPM and operates satisfactorily at 20 RPM

suitable for a variety of machine applications. Satisfactory operation is obtainable at a speed as low as 20 RPM, and the motor can be reversed if necessary at speeds up to 3000 RPM. The one horsepower

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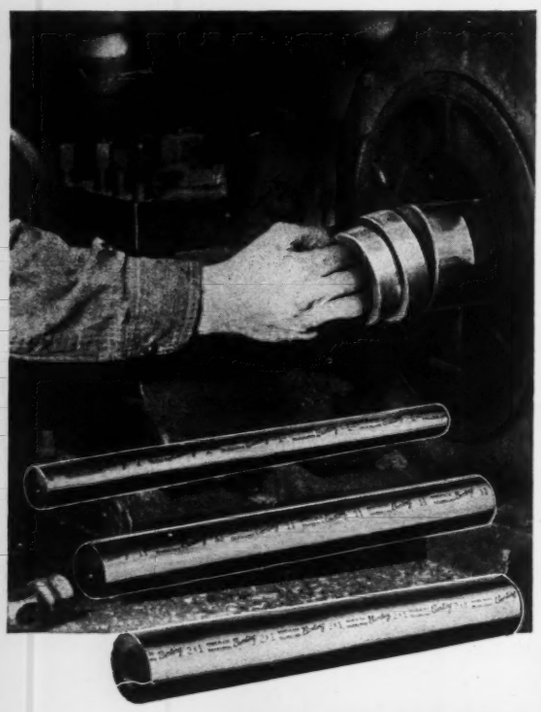

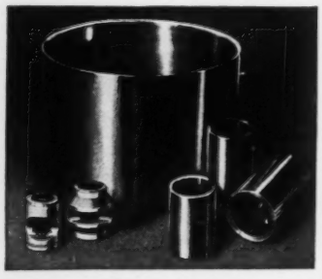

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BUNTING Bearing Bronze Machined and Centered Cored and Solid Bars save you more than their cost in set-up and tooling time as compared with rough cast bars. Being 13 inches long, they cut into multiples of standard bearing lengths without excessive waste. 131 stock sizes. Ask your wholesaler or write for current catalog.

Bunting Bronze Standardized Bearings completely machined and finished—ready for assembly—are available from stock in hundreds of different sizes for immediate installation in every usual application. Write for latest catalog.

Bunting Bronze Bearings made to exact specifications for all makes of electric motors from 1/40 hp to 60 hp are available from stock instantly at any time. Write for catalog. . . The Bunting Brass and Bronze Company, Toledo, Ohio. . . Branches and Warehouses in All Principal Cities.

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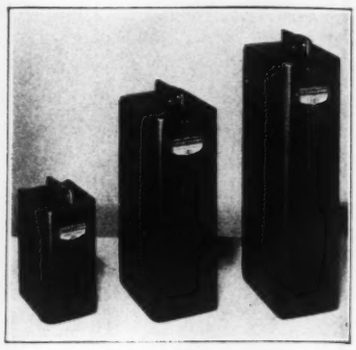
MACHINED AND CENTERED BRONZE BARS

ANTI-FRICTION BABBITT

unit as well as larger sizes can be built with a variable speed adjustment or for constant speed.

Controllers Permit Speed Regulation

DEVELOPED for use with reversible alternating current squirrel cage motors and reversing or non-reversing multispeed squirrel cage motors, Cutler-Hammer, Inc., 328 North 12th street, Milwaukee, Wis., has brought out a new line of fractional horsepower

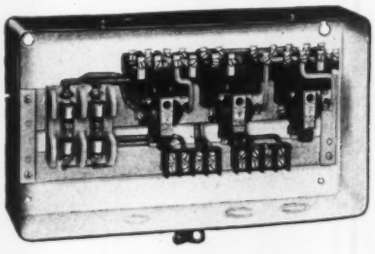


Drum controllers are enclosed in an "airstyled" removable case

drum controllers. They are particularly suitable for use with motors driving machine tools and similar machines where speed regulation is desired. An "airstyled" removable case encloses a compact mechanism offering such features as insulated cylinder to which the segments are firmly secured without screws; non-stubbing, renewable contact fingers easily accessible for wiring, and a positive action, self-indexing drum.

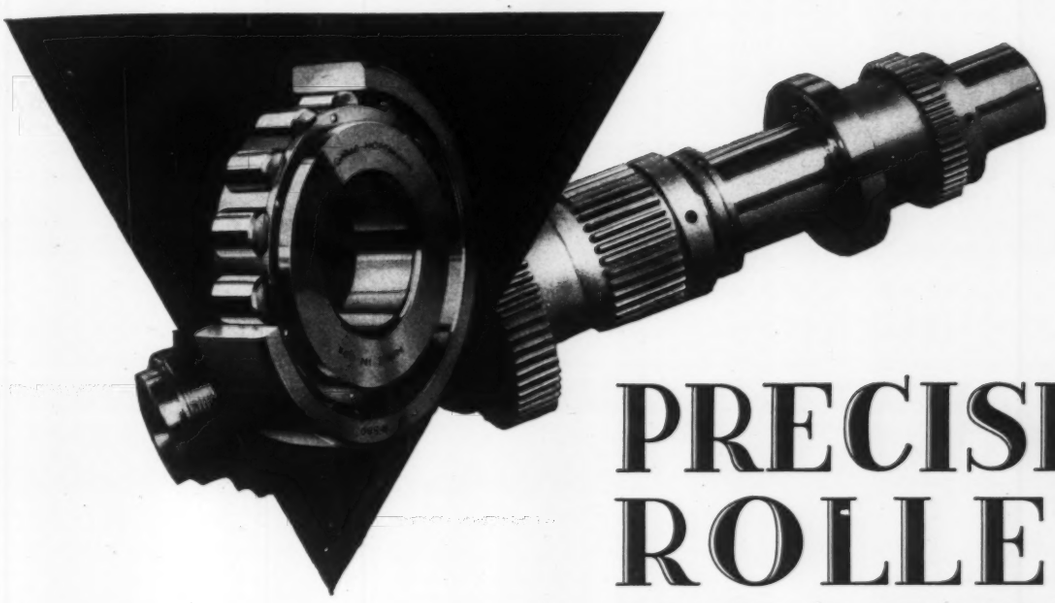
Pilot Control Alternates Pumps

ALTERNATING of duplex pumping units may now be accomplished readily with an automatic pilot control introduced recently by the Allen-Bradley Co., 1311 South First street, Milwaukee, Wis. The con-



Any type of switch may be used with the automatic pilot control for duplex pumping units

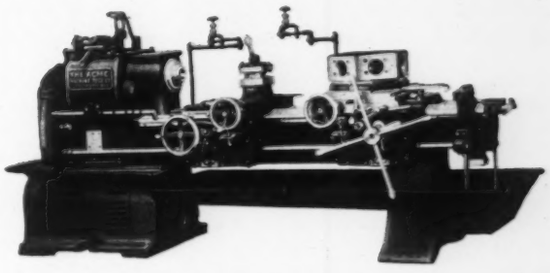
trol panel, which is composed of three Allen-Bradley 700 relays, can be used with any standard float switch and motor starters. It automatically switches the float switch control circuit from one pump starter to the other each time the unit operates. Although the electric alternator panel was developed primarily for



PRECISION ROLLER BEARINGS

for Machine Tool Spindles!

NORMA-HOFFMANN CYLINDRICAL ROLLER BEARINGS meet spindle conditions perfectly from the standpoint of a simpler design, elimination of radial looseness and vibration, and assurance of clean, chatter-free work. * * * * * The rigid mounting, both of outer ring in the housing and of inner ring with roller assembly on the spindle, combined with the extreme PRECISION of the bearings themselves, guards against looseness or chatter. The unimpeded endwise movement permitted by the cylindrical rollers, ideally provides for expansion and contraction of the spindle. * * * * * The very high load capacity of these NORMA-HOFFMANN Bearings obviates the use of a double "floating" bearing in many applications—making for simpler, more compact design, and cooler operation even at very high speeds.



The Acme Machine Tool Co., of Cincinnati is one of the many builders of lathes and other fine machine tools who employ NORMA-HOFFMANN PRECISION BEARINGS to secure greater wear resistance, rigidity, longer life, and better machine performance. Their Semi-Universal and Full Universal Turret Lathes (pictured above), as well as their Model "R" Geared Head Turret Lathes, have NORMA-HOFFMANN PRECISION ROLLER BEARINGS on the spindles.

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ANNOUNCING

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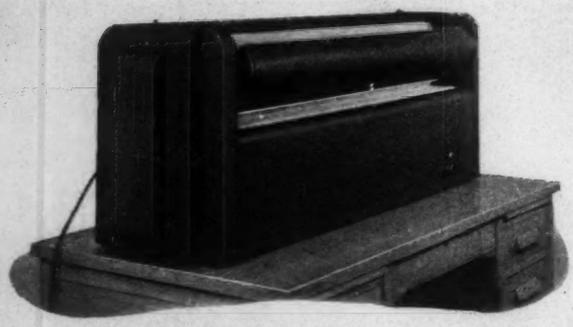

...THE BRUNING BW PRINTER

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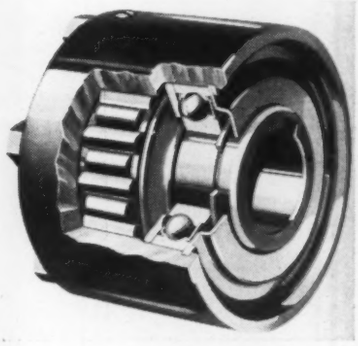
duplex pump installations, it can be used for any type of duplex motor application, such as refrigerating units, fans and compressors where alternate operation of the units is desired. The pilot control device may be a pressure switch, vacuum switch, thermostat, or two-wire pushbutton instead of the usual float switch.

Compact Clutch Developed

DESIGNED to fill the need for a simple, high-grade, inexpensive clutch to transmit power in one direction, a new high-torque indexing and free-wheeling clutch has been announced by Morse Chain Co., Ithaca, N. Y. Smooth cam action and the elimination of ratchet noise and backlash have been accomplished in this new unit. Multiple cams are used in the clutch, spaced alternately with hardened and ground steel rollers to distribute the load evenly on each cam—a feature which permits high torque loads without danger to the cam surfaces and allows greater cam contact surface for a given clutch diameter.

The cam action is governed by two leaf springs



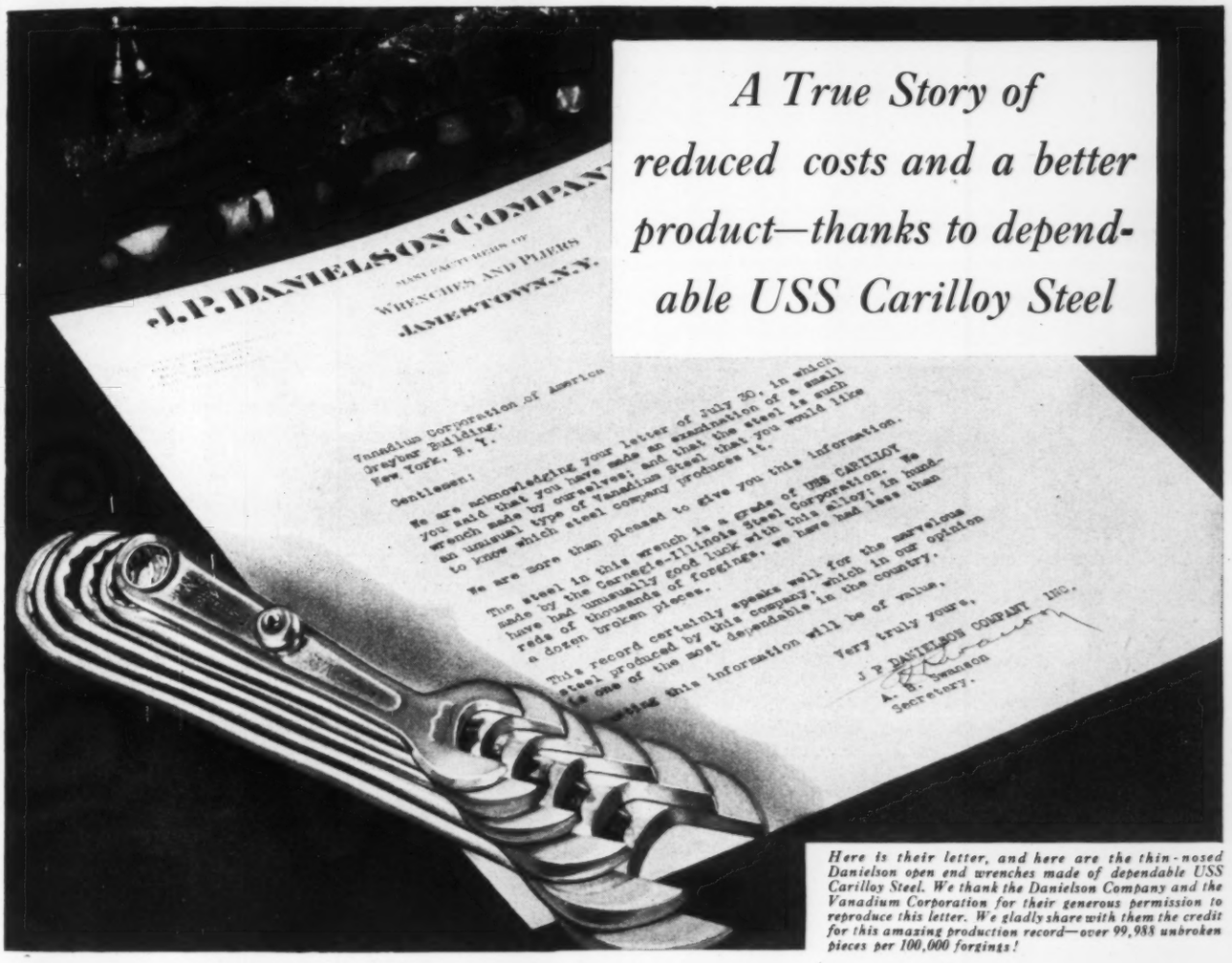
Backlash and ratchet noise are eliminated in free-wheeling clutch by the use of multiple cams

that are in contact with shouldered surfaces milled at each end of the cams. The point of spring contact is such that a rocking action is created, with the fulcrum point at the center of the cams. Thus, when the speed of the inner and outer races synchronize, the cams immediately roll into locking or driving position. A ball bearing at one end separates the members and stabilizes the load. The opposite end of the unit is prepared for the attachment of sprocket wheel, ratchet wheel or belt pulley. Lubrication is self-contained.

Speed Reducer Line Announced

AN ADDITION to the line of Hygrade worm gear speed reducers has been announced by the Foote Bros. Gear and Machine Corp., 5301 South Western blvd., Chicago. The new size has a center distance of 7¼ inches with ratios of 3⅞ to 1, up to 2450 to 1. Horsepower ratings range from ½ to 27½ horsepower

99,988 *out of* 100,000!


A True Story of reduced costs and a better product—thanks to dependable USS Carilloy Steel
J.P. DANIELSON COMPANY
WRENCHES AND PLIERS
JAMESTOWN, N.Y.
Vanadium Corporation of America
Graybar Building,
New York, N. Y.
Gentlemen:
We are acknowledging your letter of July 30, in which you said that you have made an examination of a small wrench made by ourselves; and that the steel is such an unusual type of Vanadium Steel that you would like to know which steel company produces it.
We are sore than pleased to give you this information.
The steel in this wrench is a grade of USS CARILLOY made by the Carnegie-Illinois Steel Corporation. We have had unusually good luck with this alloy; in hundreds of thousands of forgings, we have had less than a dozen broken pieces.
This record certainly speaks well for the marvelous steel produced by this company, which in our opinion is one of the most dependable in the country.
Very truly yours,
J P DANIELSON COMPANY INC.
A. E. Swanson
Secretary.

Here is their letter, and here are the thin-nosed Danielson open end wrenches made of dependable USS Carilloy Steel. We thank the Danielson Company and the Vanadium Corporation for their generous permission to reproduce this letter. We gladly share with them the credit for this amazing production record—over 99,988 unbroken pieces per 100,000 forgings!

ONLY by chance did we happen to learn of this interesting letter written by the J. P. Danielson Company. Note especially these important words:

> "This steel in our wrenches is a grade of USS Carilloy. We have had unusually good luck with this steel; in hundreds of thousands of forgings, we have had less than a dozen broken pieces."

In fact, the letter was addressed to the Vanadium Corporation of America. It is so obviously unsolicited and so completely candid that we believe it will interest every user of alloy steels.

Notice also this potent selling point from the Danielson Sales Catalog:—

> "Danielson Wrenches are thin — yet they have twice the strength of other thicker wrenches."

In recent advertisements we have described the consistent dependable uniformity of USS Carilloy Steels, the precision control under which they are made, and the steps we have taken to make that control possible —such as our enlarged metallurgical staff and the concentration of all alloy production in special alloy plants.

These two quotations are interesting evidence from an impartial source that USS Carilloy Steels can, in fact, help you lower production cost . . . turn out a better, more saleable product.

U·S·S CARILLOY (*alloy*) STEELS

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh — *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Another MACHINE DESIGN Achievement!

★

In this issue is presented a special Supplement devoted to the subject of "Machine Drives." Never before has a technical journal covered this phase of design so extensively in one issue.

To serve readers most effectively the Supplement has been stitched separately as a composite unit, and then stapled into the center of the magazine so that it can be taken out by removing two staples without injury to the insert or to the magazine proper. This permits filing by subject to provide ready reference.

With the editorial contents written and edited to assist designers of machinery in selecting the best possible drive for their conditions, the Supplement will find immediate acceptance and use. The advertising section constitutes a veritable "Where-To-Buy" Directory.

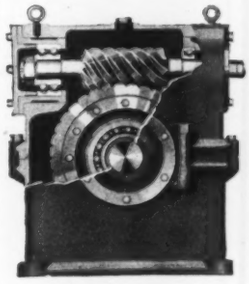
Like MACHINE DESIGN'S Directory of Materials (Fourth Edition) and the Welding Supplement published respectively in March and October, 1936, this new contribution to technical literature adds another valuable reference work to the engineer's library.

MACHINE DESIGN

The Professional Journal of Chief Engineers and Designers

Covers every size and type of machinery--- from the "Wristwatch to the Locomotive"

in single reduction, and output torque ratings of 12,600 to 21,000 inch pounds in double reduction types. Single reduction horizontal and vertical, and double reduction types are available. The addition of this size to the line makes the IXL Hygrade line cover a range in horsepower capacities from .06 to 200 horsepower on single reduction types and corresponding capacities on double reduction types.



Speed ratios vary from 3⅞ to 1, up to 2450 to 1 in new line of worm gear speed reducers

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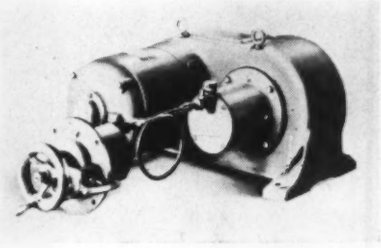
Remote Control Operates Drive

REMOTE control of the U. S. variable speed drive unit has been made possible by a hydraulic attachment brought out recently by the U. S. Electrical Motors, Inc., Los Angeles. The liquid at the remote control station cylinder is forced through copper tubing to the cylinder at the variable speed unit, the movement of which operates the changing speed mechanism. Unusually smooth regulation is achieved with this form of control and the use of any kind of mechanical linkage is unnecessary. It is particularly suitable where the variable speed unit is some distance from the control station.



Two cylinders connected by single pipe are essential parts of hydraulic remote control apparatus

---

Sieve Drive Eliminates Eccentrics

BY THE application of fundamental laws of balanced forces, the new Ajax-Shaler purifier sieve drive made by the Ajax Flexible Coupling Co., Westfield, N. Y., eliminates all necessity for eccentrics. The mechanical action of the sieve imparts a smooth,

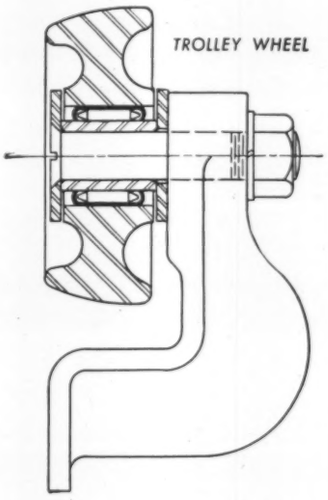
This new bearing
Permits High Radial Loads

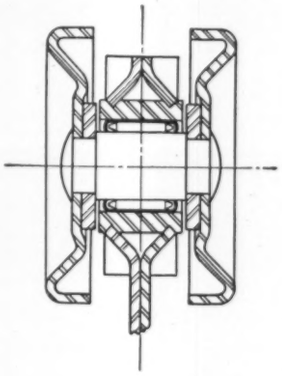
THE MANY LINES OF CONTACT DISTRIBUTE WEIGHT OVER LARGE AREA. THE IDEAL BEARING SHOULD HAVE A HIGH UNIT CAPACITY.

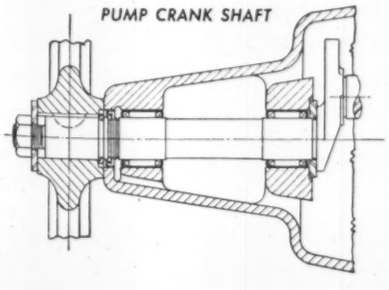
THE many lineal inches of contact provided by the comparatively large number of small diameter rollers give the new Torrington Needle Bearing an unusually high load rating.

To obtain the full capacity of the bearing assembly, close attention must be paid to materials *and* workmanship.

High Radial Load Capacity is Advantageous in Many Bearing Applications.







Precision Manufacture Gives Maximum Value

Drawing on the experience of seventy years in the manufacture of needles and twenty-five years in the production of ball bearings, The Torrington Company has built into the Needle Bearing the proper selection of steels, the precision workmanship to close tolerances and application of modern anti-friction principles.

The single retaining shell which serves as the outer raceway is drawn from carefully selected strip steel, specially treated and toughened. When pressed into the housing bore of proper dimensions, it makes an ideal race.

Each roller is carefully made to provide a uniform, highly polished surface. As the shaft is intended to serve as the inner race in the majority of applications, it should be hardened and ground to correct size. For most applications, a shaft of not less than 42 Rockwell "C" is recommended, although in actual operation under light loads and low speeds, the Torrington Needle Bearing has been used successfully on shafts with a hardness of only 25 Rockwell "C". However, for those applications where an unhardened shaft is desired, inner races will be supplied. The Torrington Needle Bearing is made with the toughness to endure hard usage and the ability to withstand high loads.

The manufacturing tolerance of the bearing assembly is held within the inspection limit of .0009". With this precision in manufacture, no weight, strain or impact occurs at any given point. This insures a minimum of starting friction, and smoothness of operation at maximum speeds.

The efficient lubricating action of the Torrington Needle Bearing contributes to the high unit capacity. The constant rotation on a film of lubricant prolongs the life of the bearing when operating under maximum loads.

The high load carrying capacity of the compact unit type Torrington Needle Bearing simplifies the design problem in many installations. The small outside diameter of the bearing allows simplification and cost reduction of surrounding members.

Considerable data that has been accumulated on many types of installations is at the disposal of manufacturers who wish to investigate the advantages of the Needle Bearing. Those interested are invited to work directly with the Torrington Engineering Department in laying out applications and planning types of assemblies.

FEATURES OF THE TORRINGTON NEEDLE BEARING

Small Size — **Ease of Installation**
Efficient Lubrication — **Low Cost**
High Radial Load Capacity

Further information and data on the new Torrington Needle Bearing, the types and sizes available for immediate shipment from stock, etc., available on request. Write for *Catalog No. 9*

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Branch Offices in all Principal Cities

TORRINGTON
NEEDLE BEARING

It's Smooth Sailing

FOR METAL WORKING MACHINES

. . . . . Equipped with

ROPER

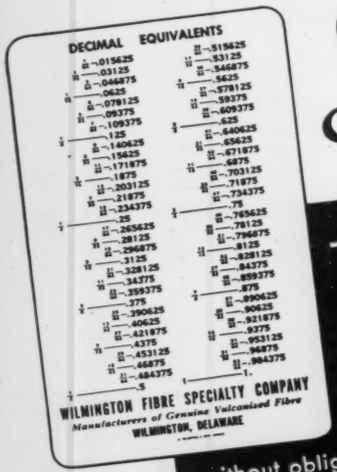
Roper Non-Pulsating Coolant Pumps handle cutting compounds and lubricants so efficiently that they make smooth sailing for metal working machines.
Power to reach the deepest bores and cuts.

PUMPS

Guaranteed not to lose prime . . . high or low pressure, delivering 1 to 20 G.P.M. Write for Bulletin R4MD.

GEO. D. ROPER CORP.
ROCKFORD, ILL.
U. S. A.

Fig. 1850



It's yours!

THIS handy, pocket-size Decimal Equivalent Chart will be sent you, upon request and without obligation. Write for yours—we'll mail it promptly.

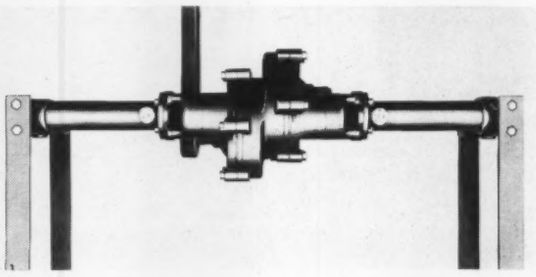
(And, if you haven't your copy of our 32-page treatise on Fibre, ask for it, too. There's a free copy awaiting you.)

With the compliments of the makers of WILMINGTON VULCANIZED FIBRE

Sheets - Rods
Tubes
Special Shapes

WILMINGTON FIBRE SPECIALTY COMPANY
MANUFACTURERS OF GENUINE VULCANIZED FIBRE
WILMINGTON, DELAWARE

perfectly uniform motion providing even flow of stock for close separation of middlings. Vibration of machine frame or building has been eliminated due to the kinetic forces being equalized in both directions



Elimination of eccentrics gives smooth uniform motion in this sieve drive

of travel and thus automatically canceling out. The driving unit is totally enclosed in an oiltight housing, reducing fire hazard and ending necessity for constant bearing adjustments. Quiet operation and low power consumption are indicated in test operations.

Cam Switches Made in Many Sizes

ROTATING cam switches, designed especially for built-in control applications and adaptable to a variety of electrical functions and machine requirements, have been recently placed on the market by the General Electric Co., Schenectady, N. Y. For non-built-in applications, the devices are available as standard switches without the flanges used for flush mounting on machines. Designated as G-E CR3300 rotating cam switches, the new line is manufactured in a number of electrical and mechanical modifications making it universally adaptable to machine application.

Rotating cam switches may be used for either flush mountings or built-in applications

Two sizes are available: Size 0, rated at 15 amperes continuous, and size 1, rated at 25 amperes continuous, both for 600 volts or less, alternating current. Four standard types are obtainable, for controlling: Single-

MAKE YOUR PRODUCT THINK FOR ITSELF...

BUILD IN A COUNTING DEVICE

Show your prospect that your product will do some of the headwork *he* now has to do—and you've got a good start towards a sale. Brains, human or mechanical, always get the jump on competition.

If your product is "educated" with a built-in counting device that will add, subtract, compute, record —it will rapidly get ahead in the world. This fact is witnessed by manufacturers of such widely varied products as duplicating machines, pumps, cameras, guns, elevators, trucks, typewriters, machine tools.

Don't say: "There's no place in my product for a built-in counting device." You can't tell without investigation and experiment—in which Veeder-Root engineers will work with you. No obligation. Write.

Counters for Every Purpose

VEEDER-ROOT

INCORPORATED

HARTFORD, CONN., U. S. A.

Offices in Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Can., Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne.

VIKING

VIKING

HYDRAULIC MOTOR DRIVEN VIKING ROTARY PUMP . . .

Viking Hydraulic Oil Pumps have gained wide popularity . . . due, we believe, to their small first cost, nominal upkeep and dependable service . . . they offer unequaled performance, made possible with Viking's famous patented principle, "A Gear Within A Gear" . . . composed of only "two moving parts" it establishes a new high in years of service . . . a new low in reduction of operating costs. We can't tell the whole story here, so we suggest that you write for complete information . . . bulletins and price list furnished at your request.

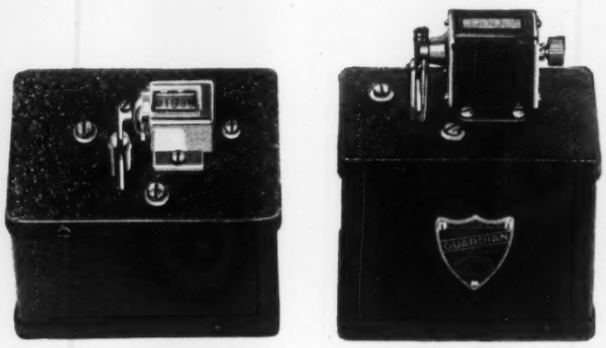
VIKING

VIKING PUMP COMPANY
Cedar Falls, Iowa

speed motors for reversing application; two-speed, separate-winding motors for non-reversing application, or for one speed forward and reverse; two-speed, single-winding motors for non-reversing application or for one speed forward and reverse; and three or four-speed motors for three or four speeds forward and one speed reverse.

Counter Controlled from Distance

REMOTE control of production is possible with a new solenoid-operated counting unit brought out by Guardian Electric, 1621-27 West Walnut street, Chicago, which utilizes Veeder-Root counters. The new unit is offered in either re-set or non-reset type of counters. Counter part is mounted on top of attractive black case containing solenoid and terminals. Mechanism is positive in action, shielded from dust, dirt and accidents by the container. This new unit is capable of handling up to 400 impulses a minute, and will not overheat or stick even when in continuous operation. A photoelectric count of objects too hot or fragile for mechanical handling can be made with the new counter.



Black case containing solenoid and terminals protects them from accident

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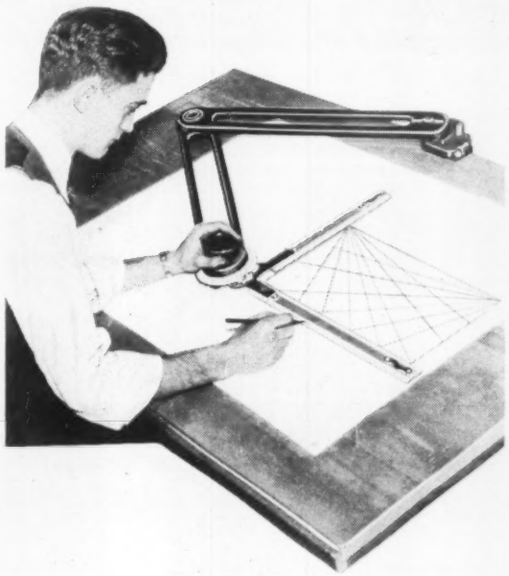
Engineering Department Equipment

Drafting Simplified By New Machine

CONTROLLED entirely by the left hand, a drafting machine designed to replace all of the tools handled most frequently by the draftsman has been brought out by the Keuffel & Esser Co., Hoboken, N. Y. It is known as the "K&E Paragon" drafting machine. The machine consists of a jointed arm of aluminum alloy, having a protractor head fitted with

two scales at 90 degrees. Parallel motion is maintained by tempered steel bands under constant tension, concealed within the arm sections. All moving parts turn on precision ball bearings.

The protractor head allows the scales to be set and locked at any angle, to move freely in angular displacement, or to stop automatically at every 15 degrees. Interchangeable scales may be quickly attached or removed to permit the use of any required



Interchangeable scales may be attached or removed quickly for any scale combination on this drafting machine

scale combination. In addition to the conventional white-edged scales, a series of special scales, made of aluminum alloy with hardened black surface and white graduations, is available for use with the machine. The drafting machine is offered in two models: A standard type, with spring counterbalance to prevent accidental motion; and a vertical type, with a weighted counterbalance.

Balancing Equipment Improved

DESIGN of the Davey portable balancing equipment, suitable for use with large turbines, fans, exhausters, pumps, motors, and other rotating machines, has recently been improved by the Electrocon Corp., 6 Varick street, New York. The photographic feature of the "two-direction" vibrometer enables records of turbine vibration to be made periodically, which is often the means of discovering troubles before they become serious. The Model S-2 vibrometer which measures in two directions simultaneously, also indicates wave form. Other improved parts of the equipment are the breaker head and phase adjuster

HOME RUN for Casey!

Imaginary Interview No. 2

It looked extremely gloomy
At the plant of Bump & Knox—
A super-order for machines
Was headed for the rocks.
A rival firm had hurried in
Without a second's lag
And had—through words and winning ways—
The order in the bag.

But B-K Salesman Casey
Was not the kind of guy
To swing and miss an order
When it came sailing by.
He buttonholed the prospect—
Discarding coat and vest—
And pointed out a dozen things
That made his product best.

"Another feature that you'll like,"
He said, with earnest mien,
"Is G-E motors and control
Are used on our machine."
"Say no more!" the buyer cried;
"The job is yours, my lad,
For G-E stuff is 'tops' with me—
I'll sign your order pad!"

Epilogue

Oh, somewhere in this favored land
Designers still will yell:
"My job's concerned with pure design—
Not helping guys to sell."
But down at good old B. & K.
Machine designers feel
That G-E motors give machines
An *extra* sales appeal.

And sure enough, if Logic rules—
If Reason still prevails—
You must admit designers should
Design their stuff for sales.

011-208

GENERAL ELECTRIC

WHICH TYPE
Meets YOUR Machine's Electrical Requirements?

HERE are five different types of motors — dozens more could be shown. Each one has a well-defined field of application; each one, in its field, provides operating economies and reliability unchallenged by any other type.

Which type of all these is best suited to your machine? Here's what General Electric offers to help you solve this problem:

A selection from thousands of ratings and sizes—motors for any electrical or mechanical requirement.

Engineering service to help you obtain a quick, profitable solution of your drive problems.

Sales offices, service shops, and warehouses near your plant and ready to serve you.

When your machine is equipped with a G-E motor and suitable G-E control, it is on its way to a sale the moment your prospect sees the G-E monogram. Why not make use of these outstanding advantages? Call your nearest G-E office, or write General Electric, Schenectady, N. Y.

020-325

GENERAL ELECTRIC

shown coupled to the synchronous motor unit. The motor is designed for balancing 60-cycle machines running at 3600, 1800 or 1200 RPM and by its use it

Synchronous motor permits balancing of machines without coupling breaker head and machine shaft

is unnecessary to couple the breaker head to the shaft of the machine. It may be placed at any point convenient to the operator. For machines running at speeds other than those given above, the breaker head is driven from the end of the shaft by a tachometer point.

Small Adding Machine Is Offered

ADDITION and subtraction have been made easy with a vest pocket adding machine introduced by Tavella Sales Co., 25 West Broadway, New York, known as the "arithmometer." The machine is constructed entirely of cold rolled steel, plated, and is grease and waterproof. It is precisely built and weighs

Adding machine is made of cold rolled steel and is grease and waterproof

only a few ounces. Multiplication and division are aided by the machine which is so simple that a child could operate it. The arithmometer is indispensable as a time saver in simple calculations.

for crank pin bearings,
eccentric straps, etc.

LAMINUM SHIMS provide accurate adjustments . . . Right at the machine! Simply p-e-e-l one or more .003" laminations at a time from the solid brass shim. Production delays avoided . . . No filing, no grinding . . . • The same economy, the same precision in factory assembly and in every service adjustment for the life of the bearings.

LAMINATED SHIM CO., INC., 21-26 44th Ave., Long Island City, N.Y.
Cleveland Detroit Milwaukee

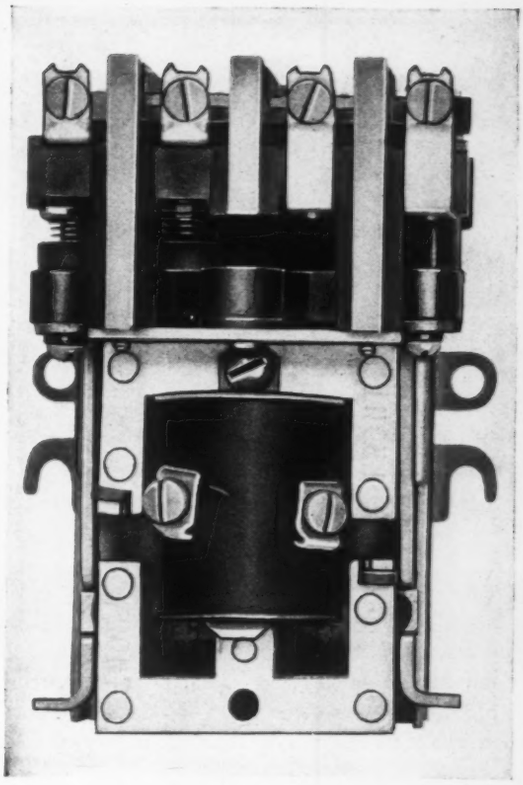
814

LAMINUM
Precision adjustment **SHIMS**

Ten different models and many different sizes in each model. All models feature the famous Gits unbreakable clear sight bottle. Plenty oil—yet no over-oiling.

GITS BROS
MANUFACTURING CO.
1861 S. KILBOURN AVE., CHICAGO

A NEW CONTACTOR



NEW—its full rating—600-volts, 10-amperes
NEW—its speed of operation
NEW—its extreme compactness

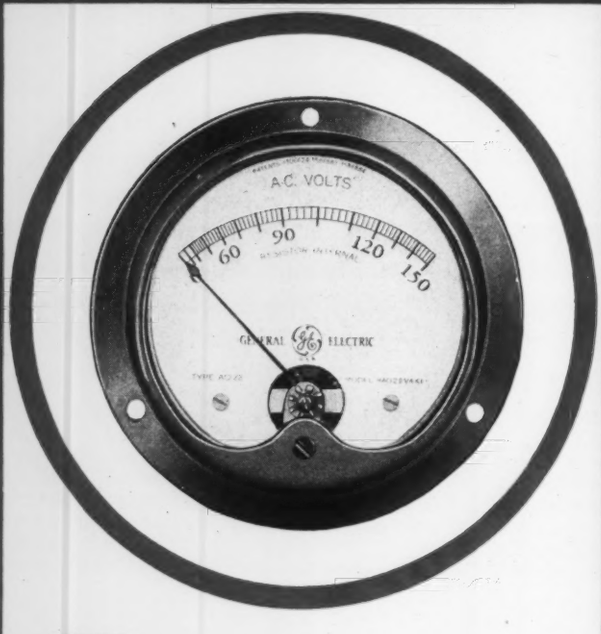
FROM its accessible, numbered terminals to its quiet, efficient, E-shaped magnet, this new Size 00 contactor offers a host of advantages to the machine designer. Many of these have been attained before, but now they are all combined in this single switch, designed for controlling the small motors on a machine and for doing relaying jobs.

There's a much bigger story about this new contactor than we can tell here. Ask your nearest G-E office for further information. General Electric Company, Schenectady, N. Y.

080-112

GENERAL ELECTRIC

DESIGNED TO HELP YOU SELL



WITH these instruments on your machines, you will get that extra beauty that adds so much to the sales appeal. Each instrument is sleek and modern looking—to meet modern requirements. Each is designed to help you sell.

And the quality is in keeping with this clean-cut appearance. For not only are they attractive, but they're easy to read, sturdily built, and—more important—highly accurate. G-E reputation—a reputation that helps you sell—is behind each instrument.

Our engineers will be glad to adapt one of these designs to meet your requirements—or, if necessary, they will submit special designs to fit your product. Their skill is shown in dozens of designs on machines throughout the country. Make General Electric your headquarters for electric measurement.

For detailed information on the small instruments for built-in service, see Bulletin GEA-1239C. Address your nearest G-E sales office, or General Electric, Dept. 6D-201, Schenectady, N. Y.

430-93

GENERAL ELECTRIC

MEETINGS *and* EXPOSITIONS

INDICATIONS are that the 41st annual convention of the American Foundrymen's Association to be held May 3 to 7 in Milwaukee will be one of the best in the history of the organization. More than 75 classifications of machines and materials will be presented by nearly 200 firms and the total space occupied will be greater than in 1918 and 1924, the two previous years when foundry exhibitions were held in Milwaukee. Among the many papers to be given at the convention several appear to be of particular interest to the designing engineer. R. A. Bull, of Chicago, will present "Designing for Steel Castings" at 10 a.m. Tuesday, May 4. . . . At 2 p.m. Tuesday a paper, "Cast Iron for Nitriding" by J. E. Hurst, Staffs, England, will be given. . . . Another which should interest the designer is "Heavy Section High Strength Irons" by V. A. Crosby and E. R. Young, Climax-Molybdenum Co., Detroit, to be given at 10 a.m. Friday, May 7.

April 19-24—

International Association for Testing Materials. Second international congress to be held in London. K. Headlam-Morley, 28 Victoria street, London, S. W. 1, England, is honorary secretary.

April 21-23—

Society of Automotive Engineers. National tractor meeting to be held at Pere Marquette hotel, Peoria, Ill. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary and general manager.

May 3-7—

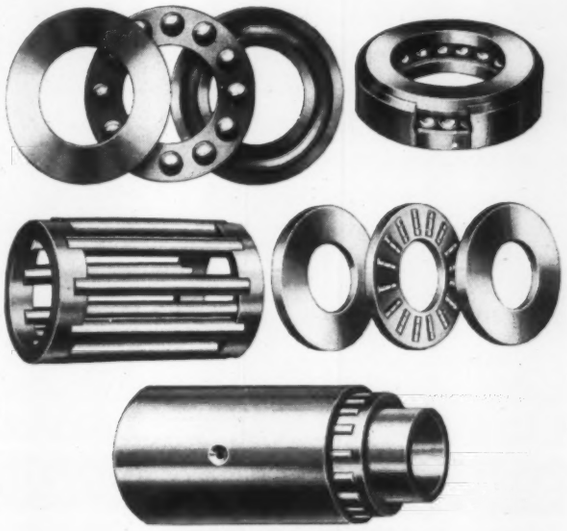
American Foundrymen's association. Forty-first annual convention and show, to be held in Milwaukee. W. F. Bornfleth, care of Cutler-Hammer Inc., Milwaukee, is general chairman.

May 5-7—

Porcelain Enamel institute. Forum to be held at the University of Illinois, Urbana, Ill. Further details may be obtained from the Porcelain Enamel institute, 612 North Michigan avenue, Chicago.

May 10-12—

Institute of Radio Engineers. Annual meeting to be held in New York. Harold P. Westman, 330 West Forty-second street, New York, is secretary.



BAL-ROL

PRECISION BEARINGS

have been selected for dependability. They have established confidence in design and construction.

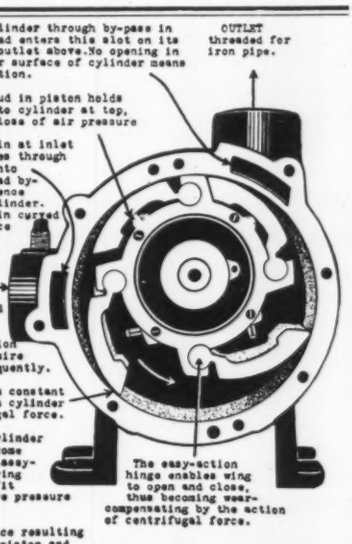
Send for our Catalog No. 12

THE BALL & ROLLER BEARING CO.

22 Howard Avenue — Danbury, Conn.

They Take Up Their Own Wear

by the action of centrifugal force. LEIMAN BROS. PATENTED **Rotary Positive Blowers** and **Vacuum Pumps** Power, Efficient and Noiseless. Use for paper feeding and handling, bottle filling, gas and oil furnaces, agitation and hundreds of other uses.


Air from cylinder through by-pass in cylinder head enters this slot on its way to the outlet above. No opening in curved inner surface of cylinder means quiet operation.
OUTLET threaded for iron pipe.
Enclosed stud in piston holds wing close to cylinder at top, preventing loss of air pressure or vacuum.
Air coming in at inlet at side comes through this slot into cylinder head by-pass and thence into the cylinder. No opening in curved inner surface of cylinder means quiet operation.
INLET threaded for standard iron pipe.
No composition tips to require renewal frequently.
Wing kept in constant contact with cylinder by centrifugal force.
Wing and cylinder surface become hard and glassy-like, insuring a perfect fit and positive pressure or vacuum.
Big air space resulting from small piston and curved wings.
The easy-action hinge enables wing to open and close, thus becoming wear-compensating by the action of centrifugal force.

A DUST COLLECTOR for Your Surface Grinder

A powerful apparatus for keeping fine grinding dust away from your work and from your own lungs.

It's a Great Protection Against Lung Dust Diseases

Get the free information.

Machine Design Can Be Greatly Helped

by using air movement instead of mechanical devices. Consult with our experienced engineers about air pumps and their uses

LEIMAN BROS. PATENTED **Rotary Air Pumps** are standard equipment on many automatic machines.

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177 Christee Street, Newark, N. J.

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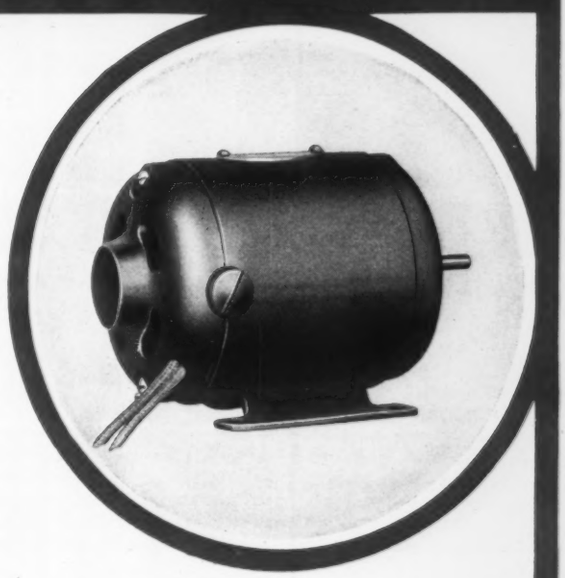
Makers of Good Machinery for 50 Years.

HOW TO REDUCE BULK IN YOUR MACHINES

Use G-E Series-Wound Motors



HAVE you the problem of reducing the size of small motor-driven machines? If so, it will pay you to investigate the use of G-E fractional-horsepower, series-wound motors for those applications where the load is directly connected and the service intermittent. Hair dryers, food mixers, and portable tools are typical applications.

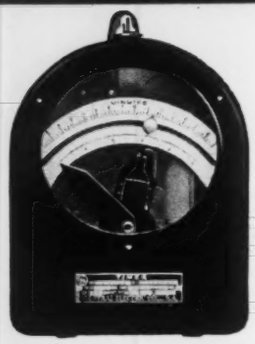
Build this powerful little motor directly into your machines — either by making the motor housing part of the finished device, or by using a set of motor parts for built-in applications. Your devices will be lighter in weight, more compact, and more pleasing to the eye.

Series-wound motors are applicable to many devices and are available in a wide variety of horsepower and speed ratings. Our engineers have made many money-saving suggestions to manufacturers for the use of this and other types of G-E fractional-horsepower motors. Why not avail yourself of their services? Write to General Electric Company, Dept. 6B-201, Schenectady, New York.

070-184

GENERAL ELECTRIC

WHEN TIME SAVES MONEY
YOU PROFIT



CONTROL of timing helps you save your customer money. It reduces spoilage, reduces waste, and leads to better products and more efficient workmen. All these are economies in which he, and you, are interested.

You can give him these economies and profit yourself by putting G-E time switches on your machines. This accurate, automatic control offers you additional selling points and greater opportunities for sales. Every time it saves your customer money, you profit.

Here are examples of its use:

Hydraulic presses
Tire molds
Plastics molds
Heat-treating equipment
Many other curing processes
Carpet driers
Photographic printing machines
Laundry-type washing machine
Fire-pump control
Paint mixers
Cement mixers
Asphalt mixers
Dough and other batch mixers
Violet-ray apparatus
Safes, cash boxes, cash drawers, and other money-protective devices
Conveyor-load signaling

Would you like to know how a G-E time switch can help your machine? Write to your nearest G-E sales office, or Dept. 6D-201, General Electric, Schenectady, N. Y.

440-108

GENERAL ELECTRIC

MANUFACTURERS' PUBLICATIONS

ALLOYS (COPPER)—News of developments in brass, bronze and copper will be carried in a monthly publication, "Copper Alloy Bulletin", issued by Bridgeport Brass Co., Bridgeport, Conn. The March number, the first issue of the bulletin, contains a digest of recent information and news of new developments of interest to industrial consumers of copper and its alloys.

BEARINGS—Illustrated and complete in every detail, Bulletin No. 370, published by Johnson Bronze Co., New Castle, Pa., contains a comprehensive line of machine-finished, ready for assembly general purpose bearings, listed in progressive and numerical order. It also includes information on bronze cored and solid bars, hexagon bars, lead and tin-base babbitt and graphited bronze bearings.

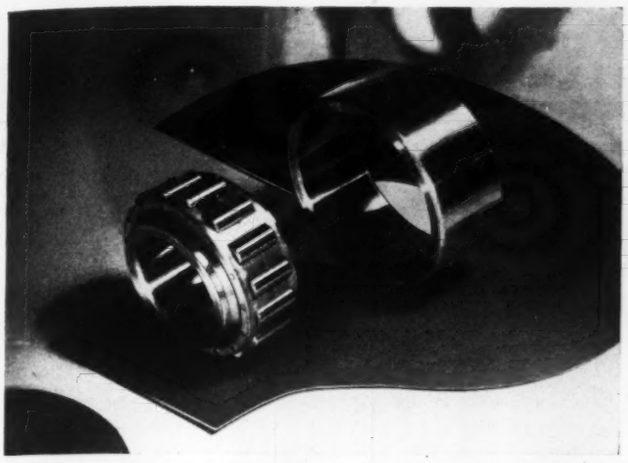
BEARINGS—Catalog No. 102 of Nice Ball Bearing Co., Nicetown, Philadelphia, includes information on new ground precision radial bearings, ball bearings, ball retainers, thrust ball bearings, combination type ball bearings, sheaves, wheels and casters. Numerous illustrations, cross sectional drawings, and various tables of specifications are given in this catalog.

CONTROLS (ELECTRICAL)—In a new 16-page catalog issued by M. H. Rhodes Inc., Rockefeller center, New York, Mark-Time portable switches, coin meters, and industrial switches for built-in applications are covered. The portable switches, offered in a self-contained Bakelite case, are designed to operate on both direct and alternating currents, at any cycle.

COUPLINGS—Specifications and characteristics of the Universal Giant Flexible Couplings Type "E" are given in a leaflet recently released by T. B. Wood's Sons Co., Chambersburg, Pa.

COUPLINGS—Flexoid industrial couplings are described and illustrated in a folder issued by Smith Power Transmission Co., 1213 West Third street, Cleveland. Usual and special applications of the couplings as well as various specifications are given.

DRIVES—Complete information on gears, sprockets, speed reducers, flexible couplings and industrial equipment is given in Catalog No. 58 entitled "Gears, Sprockets and Speed Reducers", issued by Charles Bond Co., 617 Arch street, Philadelphia. Published in a handy pocket



HOW DO YOU SPECIFY YOUR BEARINGS?

Engineers and Production Men who ask for a Rollway Analysis of their bearing applications are taking an opportunity to round out their study completely. Rollway has concentrated its comprehensive experience in the cylindrical roller field and can help you judge *accurately* the adaptation of cylindrical bearings to your problem.

Rollway will be glad to furnish an analysis without obligation.

ROLLWAY BEARING CO., INC., SYRACUSE, N. Y. Factory representatives in—Boston, Chicago, Cleveland, Detroit, Philadelphia, Pittsburgh, and Youngstown. Agents: Houston, Texas; Tulsa, Okla.; Birmingham, Ala.; Los Angeles, San Francisco, Portland, and Seattle.

CYLINDRICAL ROLLER

ROLLWAY BEARINGS

---

a **HANDY GUIDE..**

IN SPECIFYING THE RIGHT FELT FOR THE RIGHT APPLICATION

Booth
FELT SAM
Write for it!
For quick, convenient reference in selecting the right type of felt for any purpose. Complete with sample swatches. Standard file size. Mailed to any felt user—no charge . . . no obligation . . . no sales follow-up.
BOOTH FELT COMPANY, INC.
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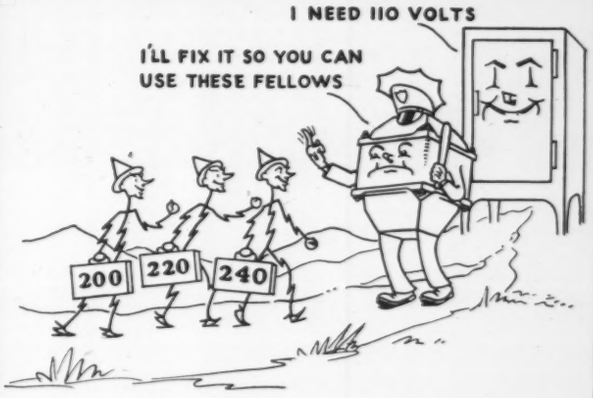
739

TRADE **Booth** MARK

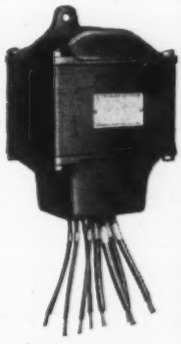
PRECISION CUT FELT

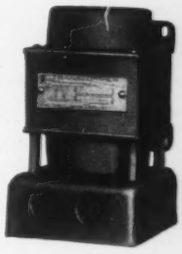
SMALL AUTOTRANSFORMERS PUT SAVINGS "ON ICE"



LAST year one refrigerator manufacturer used more than 2000 small G-E autotransformers for supplying the correct voltage to refrigerators shipped abroad. Voltages vary widely in different parts of the world, but by supplying these transformers, the manufacturer was able to use standard 110-volt, 60/50-cycle motors on the refrigerators he sold. This meant big savings in motor costs and in stock expense.

This is only one of the many ways in which small air-cooled transformers are putting money in the pockets of those who use them. They will supply low voltages from standard circuits—for greater safety in operating portable tools, or for built-in lighting. They will step up the voltage to the proper level at your motors—to improve plant operation. G-E air-cooled transformers can serve you well in a multitude of applications. If you have a problem, let us know. We'll be glad to cooperate. General Electric, Schenectady, New York.





320-74

GENERAL ELECTRIC

Courtesy United Air Lines

Fast . . . Reliable
RELAYS BY GUARDIAN

When these great liners hurtle from coast to coast, covering distances in a few hours that formerly took days, they're guided and guarded by Relays by Guardian. They depend on Guardian Relays for automatic band switching of the radio aloft and aground . . . protecting the instruments against sudden overloads . . . automatically lighting the landing field flood lights.

These units must not fail—lives depend upon their perfect functioning—therefore the builders specify Relays by Guardian.

Send us your relay problems. We'll gladly submit sample relays, made to your specifications without cost or obligations.

Solenoids—Step-up Switches—Counters

Write for illustrated catalog, "Relays by Guardian"

GUARDIAN ELECTRIC
1624 West Walnut Street **Chicago • Illinois**

RACINE
Variable Volume Hydraulic Pump

A thoroughly proven, efficient pump for power transmission.

Capacities—
0 to 2000
0 to 4000
0 to 6000
cu. in. per min.

The variable volume feature eliminates by-passing of surplus oil, decreases heating and reduces horse-power requirements. Rated for pressures up to 1000 pounds per square inch.

Successfully applied and proven highly satisfactory on such applications as:

Presses
Die Casting Machines
Welding Machines
Chucking Operations
Machine Tools
Table Movements
Stokers
Conveyors
Broaching Machines
Bending and Rolling Equipment, etc.

A variety of valves and controls are available for standard operations

RACINE TOOL & MACHINE CO.
1773 State St. Racine, Wis.

size, this 176-page catalog contains complete information, prices and directions for ordering, together with numerous tables and charts of general gear data. Another new 20-page booklet, (GA-48), published by the company, gives information on 14 different types of speed reducers, with ratios ranging from 5-1 to 2500-1; fractional horsepower units are especially featured.

DRIVES—Detailed data on the manufacture, installation and application of the "D-V" drive are given in Bulletin A-209, prepared by Dodge Mfg. Corp., Mishawaka, Ind. Specifications and characteristics of the V-belts, various types of sheaves, and drive units are also discussed, as well as important factors to be considered in the selection of a proper drive. Engineering data and numerous tables will be of help in making the selection.

DRIVES—Two folders, issued by Janette Mfg. Co., 556 West Monroe street, Chicago, present detailed information and illustrations of the 16 motorized speed reducers manufactured by the company. These motorized reducers are built for every purpose, and range from 1 50 to 7½ horsepower.

FASTENINGS—Dardelet Threadlock Corp., 55 Liberty street, New York, has published a bulletin on self-locking screw thread bolts and nuts. This bulletin describes and illustrates the screw thread, shows how it works, and discusses its advantages.

LIGHTING—In a booklet prepared by the Nela Park engineering department of General Electric Co., Cleveland, entitled "Lighting for Seeing in the Office", recommendations are made for the proper type of lighting to be used in different types of offices, including drafting and engineering offices. Painting of walls and its relationship to good lighting is also discussed.

SPRINGS — Complete, semitechnical discussions of springmaking in all its forms is offered by Barnes-Gibson-Raymond, 6400 Miller avenue, Detroit, in its new 88-page catalog "The Art and Science of Spring Making". This catalog will be helpful in designing or buying springs. It discusses the characteristics of the many spring types, numerous problems in design, and also presents tables and formulas for quick accurate use which are the result of research and laboratory experiments.

WELDED PARTS AND EQUIPMENT—"How to Weld Twenty-nine Metals", prepared by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is a comprehensive book covering the procedure, conditions and materials for welding modern alloys. Specific data for welding all types of joints with varying thicknesses of metal, such as electrode, diameter, welding current, speeds, deposition, etc., are included. Copies of the book are available from the company at 50 cents each.

WESTERN UNION USES G-E TEXTOLITE AND LARGE-UNIT MOLDING . . . REDUCES FABRICATING AND FINISHING COSTS

The new housing for the Western Union Printer is molded of Textolite by General Electric. This plastic housing, made possible through the G-E development of large-unit molding, opens a new line of thought on product design to engineers and designers — particularly those who are confronted with the problem of covering a mechanism with a large hood for protection and finished appearance.

To fabricate such a housing out of other materials, means many costly operations including surface finishing. Whereas, a Textolite hood, like the Western Union housing, is molded to exact shape in one operation and is shipped to you ready for assembly with no plating, painting or buffing to increase costs.

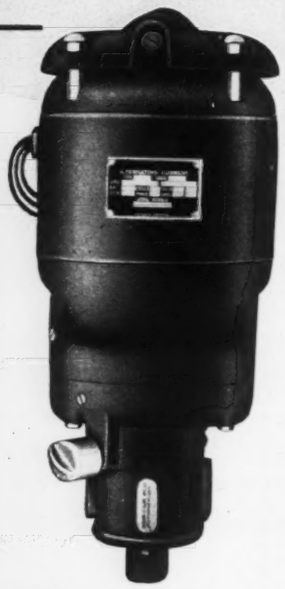
Consider G-E Textolite for similar applications and learn how you, too, can secure permanent finish, molded color, economical assembly and an attractive durable housing at lower cost. Take advantage of General Electric's large-unit molding equipment. For data and recommendations write Section P-104, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

Plastics

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

MOTORPUMPS *give Flexibility*—



Vertical Mounting may be **your** solution . . . for a compact, self-contained, efficient rotary geared pump installation. But we can supply the **horizontal mounting** as well—an increasingly popular type. May we send details? Ask for Nos. 101-102-103 ROTARY GEARED MOTOR-PUMPS

Brown & Sharpe Mfg. Co.
Providence, R. I.

BROWN & SHARPE PUMPS

B·S

METALINE
OILLESS BRONZE
BEARINGS

Special Bearings — all sizes — all shapes

• Metaline Oilless Bronze Bearings are being used in the steel industry where due to heat, water, inaccessibility or contamination of work in process, it is impractical or impossible to use oil or grease.

Consult Us Concerning Your Bearing Problems

R. W. RHOADES METALINE CO., INC.
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What Not to Patent

(*Concluded from Page* 23)

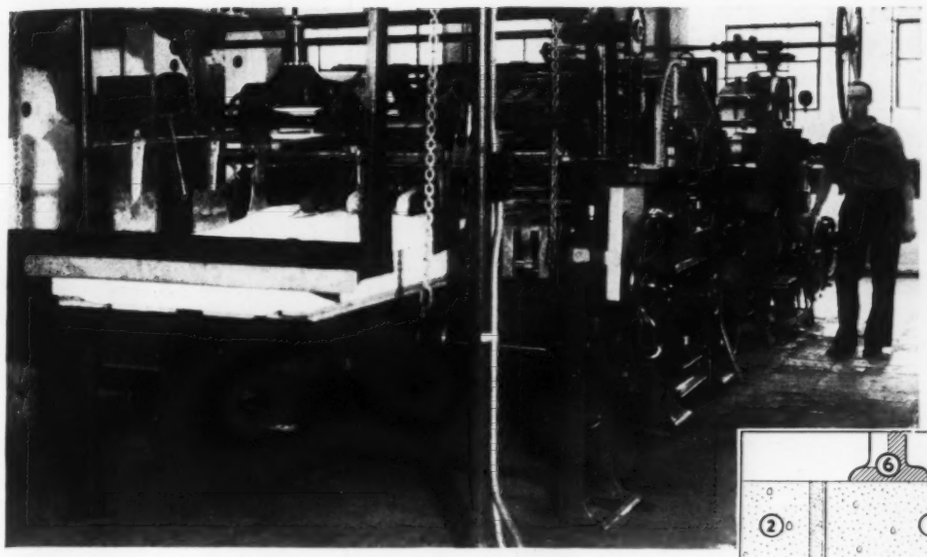
fact that the difficulty in detecting what the other companies are doing is lessened.

In forecasting the possible chances of obtaining a good patent, the decision to file or not to file should depend upon the facts surrounding each invention, considered in the light of the general principles embodied in the company's patent policy. Under a conservative policy, other things remaining balanced, the company would probably not file if the probable issuance of a good patent appears doubtful. On the other hand, under a liberal policy the company would likely file and take every chance to secure all possible protection. While it is difficult to say which policy is the better, a company is taking less risk under a liberal patent policy, because the failure to file one single doubtful application may result in the loss of considerable business and hinder progress.

Obtain Patents Outside of Field

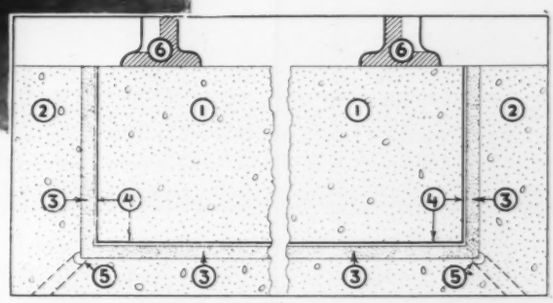
Instead of relying on patent protection to give them exclusive control of the marketing of their products, some companies attempt to keep exclusive control through advertising and by giving better quality goods at lower costs, together with rendering excellent service to the customer. On the other hand, there are manufacturers who protect every phase of their developments, and others who even secure patents outside of their field to advance the sales of their products. An example of this latter situation is found in the fact that several motor manufacturers and some machine tool builders patent control circuits (such as the one in *Fig.* 5 for reel governing) so that they may dominate the fields covered by these circuits and so control the sale of motors on machines in these fields.

It is the selection between the methods of maintaining exclusive control of one's product that determines the patent policy of the company. If a company decides to rely, as mentioned, upon its advertising, the giving of better quality goods at lower cost and excellent service rather than upon its patent protection, then the company's policy may be characterized as rather conservative. If the reverse situation holds true, then the company's policy may be characterized as liberal. From this it naturally follows that if the company has a conservative patent policy it will spend very little money upon patent protection, while under a liberal policy it may spend money quite freely. At this point it may be worth while to express the fact that the worst mistake a company can make, in the event that it decides to file a patent application, is to curtail the patent prosecution expense to the point of crippling the patent, when the spending of a few more dollars would have produced a strong patent rather than a crippled one.



— MAXIMUM LOADING ON ISOLATOR, ONLY 18 LBS. PER SQ. IN.

1. "Floating" slab
2. Surrounding floor
3. Isolator; wool FELT, 1" thick
4. Tar paper lining
5. Drains
6. Machine-feet



15 TONS "floated" on FELT

ENGINEERED TO THE JOB *by Felters for the* HAMMERMILL PAPER CO.

THE Hammermill Paper Co., makers of nationally known Hammermill Bond paper, experienced a serious vibration problem from newly installed embossing and cutting machines. Efficiency of surrounding machinery was considerably reduced. A solution was found in mounting this new equipment on heavy concrete slabs which were completely isolated from their surroundings by cushions of wool felt.

The detailed illustration shows how the FELT was installed as recommended by *FELTERS* engineers. Standing beside these machines, with one foot on the "floating" slab and the other on the surrounding floor, you can distinctly feel the slab moving up and down—yet no vibration is perceptible in the floor.

Write for an interesting booklet, "A Study of Vibration in Plant Machinery" — mailed to executives without cost or obligation.

FELT may furnish the answer to some puzzling production or maintenance problem in *your* plant. Consult our Industrial Engineering Division on *any* problem involving present or possible uses of FELT.

THE FELTERS COMPANY, INC., Dept. MD, 210 South Street, Boston

Manufacturers of Felt and Felt Products

SALES OFFICES IN PRINCIPAL CITIES

Business and Sales Briefs . . . . . .

Reliance Electric & Engineering Co., Cleveland, has added Elwood H. Koontz to its sale staff in Philadelphia, and J. Lawrence Buell Jr. as district manager at Detroit, with Z. A. Reader and Frank J. Denison as associates.

* * *

R. B. Hill has opened an office at 516 Railway Exchange building, Chicago, to represent Lewis Bolt & Nut Co., Minneapolis.

* * *

Cincinnati Milling Machine Co., Cincinnati, has recently acquired Blackburn Foundry Co., Cincinnati, for the production of castings utilizing Meehanite metal.

* * *

Cooper-Bessemer Corp., Mt. Vernon, O., has announced the reopening of its Mt. Vernon, O., foundry for the production of Meehanite castings.

* * *

E. G. Akridge has been appointed direct factory representative in the Detroit territory by Foote Bros. Gear & Machine Corp., Chicago, succeeding Thomas Lord, resigned. F. A. Emmons Jr. has been named to take over the territory on the north side of Chicago vacated by Mr. Akridge. Harry Harrison becomes sales engineer in the central territory in Chicago.

* * *

Ajax Flexible Coupling Co., Westfield, N. Y., has moved its Pittsburgh sales office to 970-B Union Trust building. J. Guy Griffith is the representative.

* * *

Bunting Brass & Bronze Co. has moved its New York city branch office into new and larger quarters, located on the street floor at 155 Baxter street, near Grand.

* * *

For many years associated with Goulds Pumps Inc., J. B. Trotman becomes manager of the "T" pump division of Roots-Connersville Blower Corp., Connersville, Ind.

* * *

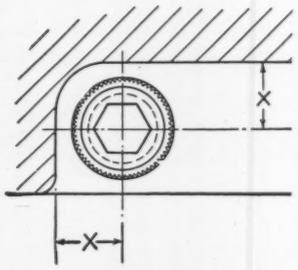
Plans for the construction of a one-story addition to cost about $40,000 with equipment are being made by Norma-Hoffman Bearings Corp., Hamilton avenue, Stamford, Conn.

* * *

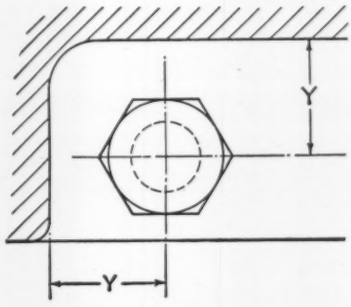
Organization of Modern Plastics Corp., Benton Harbor, Mich., to do general manufacturing has been announced.

* * *

In the March issue of MACHINE DESIGN, it was erroneously stated that T. D. Montgomery had been appointed manager of the sales division of Cutler-Hammer Inc., Milwaukee. Mr. Montgomery was appointed manager



See how the Knurled "Unbrako" snuggles right into the corner.



Notice the great open spaces necessary for the hex-head and wrench.

FOR COMPACT DESIGNS—

The difference between "X" and "Y" in the diagrams demonstrates the decided saving in Clearance, Material, Weight and Cost made possible by using the Knurled "Unbrako" Socket Head Cap Screw.

Obviously, these savings will, in many cases, help to make difficult designs easier and much more compact. Certainly, the "Unbrako" is well worth investigation.

The Knurled "Unbrako" is the *only* Socket Cap Screw with a Knurled head; furthermore, the only one that can be locked, and that will save time in assembling.

Be sure to get our complete and interesting "Unbrako" Bulletin No. 485.

UNBRAKO

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS

JENKINTOWN, PENNA.

Box 102

BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

of the foreign sales division; G. S. Crane, vice president, is in charge of sales for the company.

* * *

Ni-Chrome Metal & Alloy Co., 4541 Homer street, Chicago, has been formed to deal in metals, alloys, chemicals and allied products.

* * *

Gerity-Adrian Mfg. Corp., 320 Logan street, Adrian, Mich., has been recently incorporated to do electroplating.

* * *

F. J. Staroba has been added to the sales staff at Chicago, of the Carboloy Co. Inc., Detroit. Mr. Staroba will cover the districts of Southern Illinois, Missouri and Kansas, replacing Mr. Deeds, assigned to Indiana and Kentucky.

* * *

William H. Borden has been appointed as Detroit representative of The Synthane Corp., Oaks, Pa., manufacturers of laminated Bakelite. Mr. Borden, who formerly represented the company in Pittsburgh, will have his offices at 7310 Woodward avenue, Detroit.

* * *

Noble Jones, who has been connected with Allegheny Steel Co. at its West Leechburg, Pa., plant for the past 15 years, has been appointed general manager, Barium Stainless Steel Corp., Canton, O.

* * *

Harnischfeger Corp., Milwaukee, has named J. P. Morrissey head of the weld rod sales division. Mr. Morrissey's former connections include experience in Russia as supervisor of the welding of locomotives and parts, six years as special representative on weld rods with Crucible Steel Co. of America, and some time with the Fusion Welding Corp., as its Philadelphia district manager.

* * *

R. C. Klemm has been appointed manager of sales, bolt and nut division, Republic Steel Corp., Cleveland, to succeed C. F. Newpher, who has joined the National Screw & Mfg. Co. Mr. Klemm has been with the Republic company and its predecessors for twenty-five years. Harry W. Schrenk has been made manager of sales, tool steel department, succeeding the late Frank J. Bauman.

* * *

Jackson Gear Co., Thirty-first street and Liberty avenue, Pittsburgh, has been organized, beginning operations on April 1, to manufacture a complete line of all types of gears for general industrial use. Executives of the company are: John J. Jackson, J. Harper Jackson and Stanley J. Jackson. John J. Jackson was one of the founders of the Pittsburgh Gear & Machine Co. and served for twenty-one years as vice president; J. Harper Jackson has been with the company since 1919 and during the last five years has been treasurer of the American Gear Manufacturers' association; and Stanley J. Jackson, who will be production manager of the new company, has been in charge of production for Pittsburgh Gear & Machine Co. since 1923.

A NEW BOOK ON SPRINGMAKING

Much of the material is new and presented for the first time . . . 88 pages . . . generously illustrated . . . full of spring facts . . . complete in formulas and up-to-the-minute engineering data . . . Contains numerous problems in design with fully worked-out examples of all spring types . . . makes it easier to design, specify and order safe and economical springs for your mechanisms.

WITHOUT OBLIGATION

this book will be sent to any executive, engineer, designer or purchasing agent who is interested in Springs. Use the coupon or request it on your letterhead.

There's a place for this book in your files

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DIVISION OF ASSOCIATED SPRING CORPORATION

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